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U. S. DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES

PROPAGATION AND DISTRIBUTION OF FOOD FISHES, 1929

By GLEN C. LEACH

FISHERIES DOCUMENT No. 1070

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PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISCAL YEAR 1929

By GLEN C. LEACH

APPENDIX XII TO REPORT OF COMMISSIONER OF FISHERIES
FOR THE FISCAL YEAR 1929

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PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1929[1]

By GLEN C. LEACH, *Assistant in Charge, Division of Fish Culture*

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INTRODUCTION

In submitting a summary of the operations of the division of fish culture for the fiscal year 1929 it is fully realized that the figures showing the numerical output of fish and fish eggs represent merely a criterion for judging the efficiency with which facilities and funds utilized for fish-cultural operations have been administered. The actual basis for judging the effectiveness of the division's efforts rests in the catch of food and game fish from waters benefiting from these activities.

The production of a record output, over 30,000,000 in excess of that for any previous year, may, therefore, be cited as evidence that every possible opportunity has been utilized to exact the maximum return from each unit of equipment and from each dollar expended. Variations of several millions in the production of eggs and fry of the marine species, of carp, and of similar nongame types are significant only in connection with the maintenance of a proportional increase in the production of the more desirable food and game species.

No valid data may be cited to show the actual results of this and previous seasons' operations in terms of actual take of fish per fisherman. Highly satisfactory records of the catch of Pacific salmon may be cited, or, conversely, a continuing decline in the catch of Great Lakes coregonids; but a number of factors other than numerical replenishment from hatcheries must be taken into consideration, and the relationships are too obscure to permit a rational evaluation of the weight of any one factor.

However, the case for artificial propagation and the continuation of fish hatcheries rests upon a very simple theorem, namely, that the planting of one or a thousand fry or fingerling fish in a body of water offers more prospect of making that area productive of fish than if no planting whatever had been done. This is particularly true in the instance where the spawn for such plantings is derived from fish caught for maket, as is the case with the shad, cod, haddock, etc. The hatchery is thereby serving as a plant for the recovery of a by-product as truly as is the establishment devoted to preparation of a marketable product from fish offal. The ensuing detailed reports are therefore designed to illustrate the efforts to make the hatchery production of real economic value as much as to show the merely technical details of hatchery operation.

Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

SPECIES HANDLED

The species appearing on the distribution records constitute a summary of the most important food and game fishes of the interior and coastal waters of the United States. The list includes 45 different varieties.

CATFISHES (SILURIDÆ):
  Catfishes (Leptops sp.).
  Horned pout (*Ameiurus nebulosus*).
SUCKERS (CATOSTOMIDÆ): Buffalo fish (Ictiobus sp.) and suckers (Catostomus sp.).
CARP (CYPRINIDÆ):
  Common carp (*Cyprinus carpio*).
  Goldfish (*Carassius auratus*).
SHAD AND HERRING (CLUPEIDÆ):
  Shad (*Alosa sapidissima*).
  Glut herring (*Pomolobus æstivalis*).
SALMONS, TROUTS, AND WHITEFISHES (SALMONIDÆ):
  Common whitefish (Coregonus sp.).
  Cisco (*Argyrosomus artedi*).
  Chinook, king, or quinnat salmon (*Oncorhynchus tschawytscha*).
  Chum salmon (*Oncorhynchus keta*).
  Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
  Silver salmon, coho salmon (*Oncorhynchus kisutch*).
  Sockeye, blueback, or red salmon (*Oncorhynchus nerka*).
  Steelhead salmon (*Salmo gairdneri*).
  Atlantic salmon (*Salmo salar*).
  Landlocked salmon (*Salmo sebago*).
  Rainbow trout (*Salmo shasta*).
  Golden trout (*Salmo roosevelti*).
  Black-spotted trout, redthroat trout (*Salmo lewisi*).
  Loch Leven trout (*Salmo levenensis*).
  Lake trout, Mackinaw trout (*Christovomer namaycush*).
  Brook trout (*Salvelinus fontinalis*).
GRAYLINGS (THYMALLIDÆ): Montana grayling (*Thymallus montanus*).
PIKES (ESOCIDÆ): Common pickerel (*Esox lucius*).
SUNFISHES, BLACK BASSES, AND CRAPPIES (CENTRARCHIDÆ):
  Crappie (*Pomoxis annularis* and *P. sparoides*).
  Largemouth black bass (*Micropterus salmoides*).
  Smallmouth black bass (*Micropterus dolomieu*).
  Rock bass (*Ambloplites rupestris*).
  Warmouth bass, goggle-eye (*Chænobryttus gulosus*).
  Green sunfish (*Apomotis cyanellus*).
  Bluegill sunfish (*Lepomis incisor*).
  Common sunfish (*Eupomotis gibbosus*).
PERCHES (PERCIDÆ):
  Pike perch (*Stizostedion vitreum*).
  Yellow perch, ringed perch (*Perca flavescens*).
STRIPED BASSES (SERRANIDÆ):
  Striped bass (*Roccus lineatus*).
  White perch (*Morone americana*).
  White bass (*Roccus chrysops*).
DRUMS (SCIAENIDÆ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*.)
CODS (GADIDÆ):
  Cod (*Gadus callarias*).
  Haddock (*Melanogrammus æglifinus*).
  Pollock (*Pollachius virens*).
FLOUNDERS (PLEURONECTIDÆ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).
MACKEREL (SCOMBRIDÆ): Common mackerel (*Scomber scombrus*).

COOPERATIVE ACTIVITIES

The bureau's contact with the majority of public and private agencies interested in the conservation of fishery resources has been the means of establishing and maintaining profitable cooperative relationships. The well-established practice of supplying surplus trout eggs, either as outright donations or on an exchange basis, to many of the States has been followed to the greatest possible extent. The bureau's egg collections, particularly in the West, have therefore been an important item in assuring a supply of trout eggs at low cost to several of the States. The bureau has also benefited by reciprocal action of a similar nature on the part of the State authorities. Acquisition of early black-spotted trout eggs from Nevada has accelerated distribution of this species in the Rocky Mountain section, and the State of Montana has furnished grayling, otherwise unavailable, in return for Loch Leven eggs, of which the bureau has an ample supply. The bureau has also acted as a clearing house through which the Eastern States, in particular, have been able to secure eggs of species unavailable from usual commercial sources. The steelhead, as well as other Pacific salmons, the lake trout, the Loch Leven, and the western strain of rainbow trout have thus been disseminated. The assignments listed below represent both the outright donations on the part of the bureau and the exchanges whereby the bureau may have received a return of equivalent value.

Cooperation has been practiced in ways other than the physical transfer of eggs and fish. The bureau has, as usual, incubated trout eggs for the State of West Virginia and lent a distribution car for transporting the resulting fish. The pike-perch hatchery on Lake Champlain, a joint project of the bureau and the States of Vermont and Pennsylvania, was operated as heretofore. The bureau has detailed employees to carry on the propagation of spiny lobsters for the State of Florida and to supervise construction of a large bass hatchery for Arkansas. A limited distribution of bass was secured from the pond at Miles City, Mont., constructed by the State on Government-owned land and stocked and operated by the bureau. Virginia is developing a fish-cultural program with the assistance of the bureau in the matter of supplying fish and the necessary technical supervision. There appears elsewhere in this report a summary of the fish-cultural activities of the various States in so far as current data could be secured. A feature of the year's work has been the strengthening of cooperative relationships with other Federal agencies, particularly the Forest Service and the National Park Service. The bureau has to the fullest possible extent honored the requisitions for fish for the national forests. One of the bureau's employees was detailed to investigate the stocking possibilities in one of the national-forest areas in Alabama.

With regard to developments in the national parks the year has shown material progress. A large new hatchery building of rustic log construction has been virtually completed, and the work of constructing living quarters is proceeding with the view of ultimately providing one of the finest trout hatcheries in the country. The plant will be in operation during the spring of 1930. In addition, there have been constructed at Mammoth Hot Springs ten 60-foot rearing pools, which will be used in retaining fish from the lake hatchery and from outside stations until October. A series of rearing pools has also been constructed at Glacier Park and the hatchery capacity enlarged, following a rearrangement of the water supply. Egg-taking operations were initiated during the spring with a collection of over 100,000 black-spotted trout eggs. Further developments in this field have been planned to compensate for the drain arising from the opening of a new road through the park within a short time. Arrangements have been completed for the appointment of a bureau employee to act as contact officer with the park service in all matters pertaining to fish culture and to map out in detail the fish-cultural possibilities in the various parks. The bureau has assumed these various obligations in addition to its primary duty of filling individual applications of private citizens for fish.

Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1929

State and species	Number
California: Atlantic salmon	25,000
Colorado:	
Chinook salmon	501.000
Lake trout	30,000
Loch Leven trout	500,000
Rainbow trout	100.000
Connecticut:	
Brook trout	50,000
Lake trout	60,000
Loch Leven trout	100,000
Georgia: Rainbow trout	141.000
Hawaii:	
Chinook salmon	18,000
Steelhead salmon	40,000
Idaho:	
Landlocked salmon	50,000
Rainbow trout	100,000
Iowa: Rainbow trout	171,000
Maine:	
Atlantic salmon	300,000
Lake trout	300,000
Maryland:	
Loch Leven trout	200.000
Rainbow trout	50,000
Michigan: Lake trout	240,000
Minnesota: Lake trout	592,000
Montana:	
Chinook salmon	500,000
Loch Leven trout	2,348,000
Rainbow trout	500,000
Nebraska: Loch Leven trout	200,000
Nevada: Rainbow trout	1,246,000
New Hampshire: Lake trout	100,000
New Mexico: Loch Leven trout	1,035,000
New York:	
Lake trout	500,000
Landlocked salmon	35,000
Steelhead salmon	100,000
North Carolina: Rainbow trout	400,000
Oregon:	
Chinook salmon	11,885.000
Silver salmon	755,000
Sockeye salmon	4,266,000
Steelhead salmon	1.408,000
Pennsylvania:	
Atlantic salmon	20,000
Common sucker	1,800,000
Cisco	8,000,000
Pike perch	28,600,000
Utah: Brook trout	52,000
Vermont:	
Loch Leven trout	150,000
Landlocked salmon	25,000
Washington:	
Brook trout	500,000
Humpback salmon	1.852,000
Lock Leven trout	500,000
Silver salmon	1,901,000
Sockeye salmon	314.000
Wyoming:	
Brook trout	100,000
Loch Leven trout	1,250,000
Rainbow trout	500,000
Total	74,410,000

FISH NURSERIES

The practice of retaining hatchery fish in rearing pools conducted and maintained by groups of sportsmen for several months before releasing them in the streams has been expanded further. A review of the accompanying table will show that the number of units operated has increased materially, with a corresponding increase in the number of fish supplied. The Windber (Pa.) and Harrisburg (Pa.) hatcheries received over 500,000 eggs, which brought the assignments to a number almost twice that of previous years. The Windber organization has constructed a splendid new hatchery building with a capacity of several million eggs.

Experience has shown that one of the most prolific sources of trouble at the nurseries has been the tendency to overstock them.

Some assignments therefore have been reduced, and there has been considerable improvement in the quantity and quality of fish produced. In addition to the Pennsylvania establishments cited above, one other hatchery, located at Barneveld, N. Y., is equipped to handle eggs, and a brood stock of trout capable of supplying limited quantities of eggs has been built up. There are now three of these projects owned by groups of sportsmen and operated as hatcheries by the bureau's employees. Such plants have actually served as substations to the bureau's main stations.

Observations appearing in the report for 1928 to the effect that the nurseries were developing in groups too closely bunched and that a special personnel will be necessary properly to care for the expansion deserve repetition. It may also be repeated that bass nurseries are needed to a greater extent than those for trout, but that prevailing conditions have made it much more difficult to develop such projects.

In addition to the fish assigned to the nurseries listed herein, many of the trout consigned upon regular applications are placed in rearing ponds that are not conducted under the auspices of the bureau. This is particularly the case in the Western States, where large nursery-pond projects have been conducted independently or under the supervision of the States. A number of the States have been active in developing the rearing-pool plan, and the impetus given by the bureau's earlier work has brought about an expansion far beyond the facilities of any single agency.

It would appear desirable to emphasize again the facts experience has shown to be essential for success in conducting the work of private fish nurseries. Any site should be inspected by an experienced fish-culturist prior to development and should not be developed at all if the investigation does not show that the proper conditions exist. Construction and development should be strictly in accord with the recommendations of the bureau or the State supervising the work, and the recommendations with regard to the operation of the plant, including the number of fish to be stocked, feeding, etc., should be followed explicitly. Above all, a conscientious caretaker should be on hand to give frequent or constant attention to the fish. A stock of small trout can not be placed in the average nursery and neglected without heavy losses ensuing.

Cooperative nurseries and rearing ponds supervised by the bureau in 1929

Locality	Number of fish supplied	Kind
Massachusetts:		
Fitchburg	400	Brook trout.
Lenox	25,000	Do.
Pittsfield	9,000	Do.
Westfield	3,500	Do.
Michigan:		
Rogers City	800,000	Lake trout.
Turtle Lake	200,000	Brook trout.
Minnesota:		
Anoka	3,000	Do.
Kimball	6,500	Do.
Lake City	20,000	Do.
Lewiston	10,000	Rainbow trout.
Mora	5,000	Brook trout.
Red Wing	10,400	Do.
Do	13,850	Rainbow trout.

Cooperative nurseries and rearing ponds supervised by the bureau in 1929—Contd.

Locality	Number of fish supplied	Kind
Minnesota—Continued.		
Rochester—Altura	60, 320	Loch Leven trout.
Rochester	8, 000	Brook trout.
Rushford (2 nurseries)	16, 500	Loch Leven trout.
Rushford	11, 050	Rainbow trout.
St. Charles	15, 080	Loch Leven trout.
Wadena	5, 000	Brook trout.
Winona	50, 000	Rainbow trout.
Do	40, 000	Brook trout.
New Hampshire:		
Merrimack	20, 000	Do.
Greenville	20, 000	Do.
Wilton	20, 000	Do.
Lebanon	25, 000	Do.
Peterboro	20, 200	Do.
New Jersey: Paterson	10, 000	Do.
New York:		
Watertown	658, 715	Do.
Malone	40, 000	Loch Leven trout.
Do	40, 000	Brook trout.
Adams	25, 000	Do.
Oneonta	60, 000	Do.
Arena	5, 000	Loch Leven trout.
Austerlitz	4, 000	Brook trout.
Barneveld	238, 455	Brook-trout eggs.
Do	113, 398	Rainbow-trout eggs.
Clyde	14, 000	Black bass.
Pennsylvania:		
Windber	267, 000	Brook-trout eggs.
Harrisburg	317, 000	Do.
Do	33, 360	Brook trout.
Chester	10, 000	Loch Leven trout.
Meyersdale	25, 000	Brook trout.
Meadeville	48	Black bass.
Renovo	40, 000	Brook trout.
Ridgway	15, 000	Rainbow trout.
Belleville	20, 000	Brook trout.
Carrollton	10, 000	Do.
Clearfield	20, 000	Do.
Muncy (2 nurseries)	55, 000	Do.
Muncy	20, 000	Loch Leven trout.
Williamsport	10, 000	Do.
Williamsport (4 nurseries)	115, 000	Brook trout.
Ebensburg	10, 000	Do.
Altoona	5, 000	Loch Leven trout.
Do	10, 000	Brook trout.
Do	10, 000	Rainbow trout.
Johnstown	10, 000	Brook trout.
Do	10, 000	Rainbow trout.
Galeton	20, 000	Brook trout.
Hazleton	20, 000	Do.
Scranton	50, 000	Do.
Pittston	10, 000	Do.
Do	5, 000	Loch Leven trout.
Bloomsburg	20, 000	Brook trout.
St. Marys	10, 000	Do.
Sharon	4, 000	Do.
Somerset	25, 000	Do.
Do	15, 000	Rainbow trout.
Chambersburg	8, 175	Brook trout.
Do	6, 000	Rainbow trout.
Jennerstown	5, 000	Brook trout.
Ligonier	15, 000	Do.
Do	25, 000	Rainbow trout.
Vermont:		
Bennington	75, 000	Brook trout.
Averill	75, 000	Do.
Do	60, 000	Lake trout.
Virginia:		
Shawsville	15, 000	Rainbow trout.
Smythe County	75, 000	Do.
Do	75, 000	Brook trout.
Wise County	7, 000	Rainbow trout.
Craig County	80, 000	Do.
Do	60, 000	Brook trout.
Bath County	30, 000	Do.
Do	20, 000	Rainbow trout.
Nelson County	17, 000	Brook trout.
West Virginia:		
Durbin	25, 000	Do.
Do	3, 000	Rainbow trout.

Cooperative nurseries and rearing ponds supervised by the bureau in 1929—Contd

Locality	Number of fish supplied	Kind
Wisconsin:		
Altoona	3,000	Rainbow trout.
Arcadia	15,000	Brook trout.
Athelstane	25,000	Do.
Boscobel	15,000	Do.
Do	5,000	Rainbow trout.
Clear Lake	8,000	Brook trout.
Darlington	5,000	Rainbow trout.
Eau Claire	2,500	Brook trout
Eau Claire (2 nurseries)	42,500	Rainbow trout.
Elroy	9,000	Brook trout
Ellsworth	40,000	Rainbow trout.
Do	5,000	Brook trout
Elmwood (2 nurseries)	6,000	Rainbow trout.
Galesville	10,000	Brook trout.
Gilmanton	3,000	Do.
Glenwood City	4,750	Do.
Hatley	9,000	Do.
Hazel Green	15,000	Do.
Holmen	13,000	Do.
Independence	15,000	Do.
La Crosse	20,000	Rainbow trout.
Do	5,000	Brook trout.
Laona	17,670	Do.
Manitowoc	5,000	Rainbow trout.
Marathon	10,000	Brook trout.
Medford	3,000	Do.
Merrill	20,000	Do.
Nekoosa	10,000	Do.
Osseo	10,000	Do.
Plum City	8,000	Do.
Port Edwards	10,000	Rainbow trout.
Prescott	5,000	Brook trout.
Rothschilds	8,000	Do.
Schofield	3,000	Do.
Shullsburg	5,000	Rainbow trout.
Sparta	3,000	Brook trout.
Stanley	14,250	Do.
Stevens Point	20,000	Rainbow trout.
Do	9,500	Brook trout.
Tomah	15,000	Do.
Tomahawk	15,000	Do.
Tunnel City	10,000	Do.
Viroqua	6,000	Rainbow trout.
Wausau	12,000	Brook trout
Westby	12,000	Rainbow trout.
Wisconsin Rapids	5,000	Do.
Total	5,006,121	

STATE FISH-CULTURAL ACTIVITIES

The propagation and distribution of fish by the States is a factor of great importance in maintaining the supply of food and game species. While a few States operate no hatcheries, State activities in others overshadow those of the Bureau of Fisheries. As a means of comparative illustration of the facilities for fish culture and the results accruing therefrom, questionnaires were sent to the States, and the information so secured is tabulated below. In interpreting these data it should be remembered that direct comparison on the basis of actual numerical output is erroneous, since several States in the East distribute their game fish at a legal size only, with the consequent reduction in numbers. Other States, particularly in the West, are still distributing small fingerlings. The smaller number of fish may therefore have a greater stocking value than the numerically greater output of other States. The information in the table is supplied by the States themselves or taken from the printed reports and covers the latest complete year upon which data could be obtained.

The totals will therefore fail to represent an aggregate country-wide distribution for any one year but are rather indicative of a normal annual output.

State fish-cultural activities

State	Distribution of—				Total
	Trout	Pondfish	Other game fish	Food fish	
Alabama		299,435			299,435
Arizona	2,480,000	40,000			2,520,000
Arkansas		1,000		8,392,000	8,393,000
California	20,202,000			4,260,000	24,462,000
Colorado	27,000,000	1,000,000			28,000,000
Connecticut	396,031	321,751	35,650,000	132,251,566	168,619,348
Florida		1,887,500		[1] 38,800,000	40,687,500
Georgia	250,000				250,000
Idaho	10,000,000				10,000,000
Illinois		1,240,000			1,240,000
Indiana		898,855	10,259,000		11,157,855
Iowa	316,240	445,042	15,880		777,162
Kansas		300,000	700,000		1,000,000
Kentucky		98,318			98,318
Louisiana		2,622,260		8,067,810	10,690,070
Maine	2,752,800		1,077,004		3,829,804
Maryland	800,000	200,000		621,990,000	622,990,000
Michigan	18,193,026	1,724,350	16,884,109	98,228,147	135,029,632
Massachusetts	446,880	747,652	45,121	3,915	1,243,568
Minnesota	4,436,000	1,527,500	595,800,000	91,029,000	692,792,500
Missouri	444,270	390,709	1,300		836,279
Montana	45,634,318	315,000		2,791,400	48,740,718
Nebraska	728,305	5,717,707			6,446,012
Nevada	3,884,248				3,884,248
New Hampshire	12,012,737	1,430	822,600	16,803,334	29,640,101
New Mexico	4,516,000				4,516,000
New Jersey	637,522	856,500	78	98,120,000	99,614,100
New York	9,622,899	528,139	147,991,500	800,417,450	958,559,988
North Carolina	3,133,000	552,812	261,435	7,000,000	10,947,247
North Dakota			64,000,000		64,000,000
Ohio		3,912,781			3,912,781
Oklahoma		966,974			966,974
Oregon	20,346,278	3,461,323		71,000,000	94,807,601
Pennsylvania	794,312	1,359,550	239,327,200	115,187,800	356,668,862
Rhode Island	41,030	600	500	[1] 1,200,000	1,242,130
South Dakota	249,115	4,554,115			4,803,230
Texas		400,000			400,000
Utah	8,018,700	2,331,870			10,350,570
Vermont	1,107,624	40,000	38,264,514		39,412,138
Washington[2]	34,111,152		25,667,150	98,567,098	158,345,400
West Virginia	1,152,000	30,100			1,182,100
Wisconsin	11.344,125	4,615,339	215,749,000	42,772,600	274,481,064
Wyoming	10,000,000				10,000,000
Total	255,050,612	43,388,612	1,392,516,391	2,256,882,120	3,947,837,735

State	Number of hatcheries	Number of employees	Expenditures	Investment
Alabama	1	2	$1,480.54	$15,000.00
Arizona	3	5	18,000.00	20,000.00
Arkansas	[3] 1	2		65,000.00
California	20			
Colorado	15	25	100,000.00	750,000.00
Connecticut	6	12	44,135.14	150,000.00
Florida	6	11	77,963.14	137,759.73
Georgia	[3] 1	2	6,000.00	
Idaho	11	20	48,000.00	82,000.00
Illinois	9	20	35,000.00	250,000.00
Indiana	5	15	49,573.00	225,000.00
Iowa	4	8	57,000.00	75,000.00
Kansas	5	11	30,500.00	80,000.00
Kentucky	2	3		80,000.00
Louisiana	3	4	5,687.48	100,000.00
Maine	12	30	71,688.32	75,000.00
Maryland	8	11	22,500.00	10,000.00
Michigan	17	75	273,896.00	642,758.37
Massachusetts	7	10	60,267.42	122,368.00
Minnesota	13	33	106,530.55	375,000.00
Missouri	7	16	53,500.91	79,650.00

[1] Lobsters.

[2] Does not include figures for county hatcheries.

[3] New.

State fish-cultural activities—Continued

State	Number of hatcheries	Number of employees	Expenditures	Investment
Montana	14	33	$85, 240. 80	----------
Nevada	1	----------	----------	----------
New Hampshire	6	21	86, 055. 51	$350, 000. 00
New Mexico	6	9	44, 000. 00	69, 251. 00
New Jersey	2	12	63, 400. 42	----------
New York	11	60	250, 000. 00	----------
North Carolina	6	17	45, 000. 00	170, 581. 34
North Dakota	1	2	5, 000. 00	15, 000. 00
Ohio	11	17	----------	----------
Oklahoma	4	30	82, 778. 00	300, 000. 00
Oregon	50	----------	226, 739. 06	----------
Pennsylvania	6	30	229, 116. 40	1, 505, 230. 00
Rhode Island	1	----------	----------	----------
South Dakota	6	8	34, 504. 49	165, 000. 00
Texas	5	15	25, 000. 00	250, 000. 00
Utah	8	11	42, 000. 00	250, 000. 00
Vermont	5	10	32, 588. 79	77, 200. 00
Washington [3]	25	73	164, 340. 82	500, 000. 00
West Virginia	[4] 4	4	12, 500. 00	10, 000. 00
Wisconsin	23	31	112, 568. 50	421, 379. 80
Wyoming	8	14	42, 500. 00	150, 000. 00
Total	359	712	2, 645, 056. 29	7, 568, 178. 24

[3] Does not include figures for county hatcheries.

[4] Nurseries.

OUTPUT

The aggregate output of 7,060,369,500 eggs, fry, and fingerling fish represents a new high total for the fish-cultural work of the bureau. Analysis of the figures for the various groups in succeeding sections will give a clearer picture of the significance of the year's operations, however. A material increase in the total arising from a heavy output of some varieties, such as carp, with a decrease in the production of Pacific salmons or trout would really constitute a retrogression from the standpoint of economic utility. Fortunately, the 1929 percentage distribution of the various groups within the total is substantially the same as in previous years, and the 30,000,000 increase represents an actual gain. The comparison of this season's output with the 5-year average will give a clearer conception of the trend of development.

Game fishes comprised only about 1 per cent of the total output, in comparison with 2.7 per cent for 1928. The decline was due entirely to the failure of the rescue work on the Mississippi River, which normally supplies well over 51 per cent of the total production of game fishes. The proportion of Pacific salmons dropped from 2.9 to about 2.2 per cent. The output of marine species (eggs and fry) was increased from 82 to 86.9 per cent, while the commercial anadromous forms as a whole receded from 4.1 to 3.5 per cent. The commercial species of the interior waters, mainly the Great Lakes, are represented by a percentage of 7.9, in comparison with 8.3 for the previous year. These slight percentage changes leave the actual numerical output for the various groups virtually the same as last year, with the total increase being carried by the marine commercial species.

The production of fingerlings dropped from 261,634,200 to 136,185,500, a decrease of 47.9 per cent. This was entirely accounted for by the failure of the rescue work, which normally supplies between 140,000,000 and 150,000,000 fish, all fingerlings. Deducting the rescued fish from the fingerling totals for 1928 and 1929, it appears that there was an actual increase of 27,762,140 fish, or 26.9 per cent in the number of fingerlings actually produced and distributed from the bureau's stations in 1929.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1929

Species	Eggs	Fry	Fingerlings	Total
Catfish			888, 100	888, 100
Buffalo fish	49, 369, 000		34, 700	49, 403, 700
Common sucker	1, 800, 000			1, 800, 000
Carp	24, 300, 000	2, 500, 000	31, 000	26, 831, 000
Shad		71, 351, 000		71, 351, 000
Glut herring		11, 500, 000		11, 500, 000
Whitefish	3, 000, 000	94, 295, 000		97, 295, 000
Cisco	9, 200, 000	123, 000, 000		132, 200, 000
Chinook salmon	14, 419, 000	925, 000	39, 049. 400	54, 393, 400
Chum salmon	765, 000	19, 153, 000	49, 000	19, 967, 000
Silver salmon	2, 101, 000	6, 049. 000	1, 398, 300	9, 548, 300
Sockeye salmon	6, 432, 000	2, 640, 000	54, 176, 900	63, 248, 900
Humpback salmon	1, 852, 000			1, 852, 000
Steelhead salmon	1, 979, 000	112, 000	1, 428, 500	3, 519, 500
Atlantic salmon	345, 000		572, 200	917, 200
Landlocked salmon	110, 000	15, 000	543, 700	668, 700
Rainbow trout	4, 685, 000	635, 000	7, 399, 200	12, 719, 200
Golden trout			9, 000	9, 000
Black-spotted trout	11, 842, 000		7, 242, 000	19, 084, 000
Loch Leven trout	7, 713, 000	5, 000	1, 496, 700	9, 214, 700
Lake trout	2, 184, 000	26, 100, 000	2, 051, 000	30, 335, 000
Brook trout	1, 542, 000	2, 407, 000	12, 906. 200	16, 855, 200
Grayling		1, 765, 000		1, 765, 000
Pike and pickerel			34, 800	34, 800
Mackerel		2, 778, 000		2, 778, 000
Crappie			1, 898, 900	1, 898, 900
Largemouth black bass		696, 000	1, 728, 900	2, 424, 900
Smallmouth black bass		664, 000	155, 000	819, 000
Rock bass			79, 000	79, 000
Warmouth bass			6, 700	6, 700
Sunfish			2, 154, 000	2, 154, 000
Pike perch	28, 600, 000	52, 150, 000	400	80, 750, 400
Yellow perch		192, 923, 000	188, 500	193, 111. 500
Striped bass		9, 661, 000		9, 661, 000
White perch			250	250
White bass			300	300
Fresh-water drum			2, 850	2, 850
Cod	2, 228, 122, 000	274, 033, 000		2, 502, 155, 000
Haddock	351, 442, 000			351, 442, 000
Pollock		358, 442, 000		358, 442, 000
Winter flounder	109, 434, 000	2, 809, 149, 000		2, 918, 583, 000
Miscellaneous fishes			660, 000	660, 000
Total	2, 861, 236, 000	4, 062, 948, 000	136, 185, 500	7, 060, 369, 500

The following table indicates the actual numerical output of the strictly game fishes, the anadromous species (which includes the shad, glut herring, salmons, etc.), the commercial species of interior waters (including the whitefish, cisco, lake trout, and pike perch), and also the marine species. Yellow perch are included with the game species, although in many sections they are also an important commercial fish. On the other hand, the pike perch has been listed as a commercial fish, although it is eagerly sought by sportsmen. A comparison of the limited number of game fish with the other varieties would indicate reasons for the bureau's difficulty in giving early and immediate attention to applications for these forms.

Game species	260, 845, 150
Anadromous species	245, 958, 300
Commercial species (Great Lakes and interior waters)	367, 411, 400
Marine species	6, 133, 400, 000
Miscellaneous species	52, 754, 650
Total	7, 060, 369, 500

EGG COLLECTIONS

While the general public is most familiar with the hatcheries, with their equipment for incubating eggs and rearing fish, the success of hatchery operations sometimes depends upon the work of the egg-collecting stations. The taking of eggs is frequently attended by hardship and sometimes hazard. It is often necessary to penetrate to remote locations to secure trout eggs in the face of adverse weather conditions in the late fall or early spring in mountainous sections in the Western States, or to go out in small boats in storms to secure cod eggs or the eggs of the Great Lakes species. In many instances the location represents the point from which eggs are shipped to the hatcheries, the bureau having no property or equipment in use. It will be noted that the total egg collections, aggregating 7,870,015,000, were smaller than those of last year, although the output of fish was greater. This was due to the high quality of the eggs, the increased percentage of hatch, and the fact that the distribution included a large number of fingerlings reserved from the previous year's hatch. The figures covering striped-bass operations represent cooperative activities with the State of North Carolina. The taking of mackerel eggs is a minor development in connection with the propagation of other marine species at the Woods Hole (Mass.) station.

The most unfavorable aspect of this phase of the work lies in the continued decline of the whitefish-egg collections. Some of the stations, particularly that at Put in Bay, Ohio, are able to obtain sufficient eggs for only a third or a half of the jar capacity, and it is necessary to handle more abundant and less desirable forms in order to utilize the equipment. With the exception of several hundred thousand brook-trout eggs purchased for stocking cooperative hatcheries, the bureau was relieved of the necessity of buying any trout eggs during the year. Field collections and the take from station brood stocks furnished sufficient rainbow, Loch Leven, and black-spotted trout eggs for exchange to fill other requirements and shortages. Requirements for all species of eggs for the coming year will probably be met without the necessity of making any purchases whatever from commercial hatcheries.

Comparison of egg collections, fiscal years 1929 and 1928

Species	1929	1928	Species	1929	1928
Buffalo fish	49,396,000	10,200,000	Black-spotted trout	16,202,200	23,115,000
White sucker	1,800,000		Loch Leven trout	15,018,100	15,767,800
Carp	28,050,000	7,500,000	Lake trout	65,354,100	85,911,340
Shad	83,806,000	51,473,000	Brook trout	16,686,110	18,500,290
Glut herring	37,740,000	223,444,000	Mackerel	3,482,000	6,237,000
Whitefish	149,712,000	198,709,500	Pike perch	228,303,000	720,610,000
Cisco	211,901,250	172,822,500	Yellow perch	211,835,000	184,890,000
Chinook salmon	49,830,200	58,792,800	Striped bass	13,786,000	9,113,000
Chum salmon	23,467,000	25,247,000	Cod	2,214,467,000	2,373,490,000
Humpback salmon	4,128,800	2,625,000	Haddock	175,737,000	311,417,000
Silver salmon	9,101,300	15,452,000	Pollock	596,182,000	218,867,000
Sockeye salmon	51,038,120	41,495,000	Winter flounder	3,219,880,000	3,054,175,000
Steelhead salmon	9,283,300	1,729,500			
Landlocked salmon	1,157,880	767,950	Total	7,870,015,000	7,887,670,100
Rainbow trout	19,377,310	21,060,480			

Egg-collecting stations

Station	Period of operation	Species handled
Baker Lake, Wash.: Brinnon, Wash	Nov. 24–Jan. 15	Chum salmon (late run).
Boothbay Harbor, Me.:		
Ebenecook Harbor, Me	Mar. 5–Apr. 15	Winter flounder.
Fisherman Island Passage, Me	Apr. 22–June 1	Cod and haddock.
Johns Bay, Me	Mar. 5–Apr. 23	Winter flounder.
	Apr. 30–June 1	Cod and haddock.
Linekins Bay, Me	Mar. 12–June 1	Winter flounder, cod, and haddock.
Little River, Me	Mar. 23–Apr. 30	Winter flounder.
Muscungus Bay, Me	Apr. 30–June 1	Cod and haddock.
Robin Hoods Cove, Me	Mar. 15–Apr. 17	Winter flounder.
Sheepscott Bay, Me	Apr. 1–June 11	Cod.
Sheepscott River, Me	Mar. 5–June 11	Winter flounder and cod.
Cape Vincent, N. Y.:		
Bowmanville, Ontario	Nov. 1–Nov. 15	Whitefish.
Brighton, Ontario	do	Do.
Charity Shoals, N. Y	Oct. 20–Nov. 5	Lake trout.
Chaumont Bay, N. Y	Nov. 6–Dec. 3	Whitefish and cisco.
Consecon, Ontario	Oct. 28–Nov. 24	Lake trout, whitefish, and cisco.
Fairhaven, N. Y	Nov. 17–Nov. 30	Cisco.
Gardenville, N. Y	Nov. 12–Nov. 24	Do.
Indian Point, Ontario	Oct. 28–Nov. 30	Lake trout, whitefish, and cisco.
Irondequoit Bay, N. Y	Dec. 6	Cisco.
Long Point, Ontario	Oct. 30–Nov. 18	Lake trout and whitefish.
Pigeon Island, Ontario	Oct. 17–Nov. 10	Lake trout.
Simcoe Island, Ontario	Oct. 25–Nov. 16	Lake trout and whitefish.
Sodus Point, N. Y	Nov. 17–Dec. 1	Cisco.
Stoney Island, N. Y	Oct. 20–Nov. 5	Lake trout.
Clackamas, Oreg.:		
Lemhi River, Idaho	Aug. 16–Sept. 3	Chinook salmon.
Upper Clackamas, Oreg	Aug. 31–Sept. 24	Do.
Williams Lake, Idaho	Apr. 30–June 10	Rainbow trout.
Craig Brook, Me.: Green Lake, Me	July 1–Nov. 22	Landlocked salmon.
Duluth, Minn.:		
Au Train, Mich	Oct. 15–Oct. 30	Lake trout.
Bemidji, Minn	Apr. 16–Apr. 30	Pike perch.
Big Traverse Bay, Mich	Oct. 15–Oct. 30	Lake trout.
Copper Harbor, Mich	Oct. 1–Oct. 12	Do.
Gay, Mich	Oct. 15–Oct. 30	Do.
Grand Marais, Mich	Oct. 18–Nov. 7	Do.
Huron Island, Mich	Oct. 15–Nov. 1	Do.
Isle Royale ports, Mich	Sept. 28–Nov. 20	Lake trout and whitefish.
Manitou Island, Mich	Oct. 13–Oct. 27	Lake trout.
Marquette, Mich	Oct. 17–Nov. 1	Do.
Munising, Mich	Oct. 20–Oct. 30	Do.
Portage Entry, Mich	Oct. 13–Nov. 2	Do.
Portage Lake Canal, Mich	Oct. 10–Nov. 2	Do.
Gloucester, Mass.:		
Boars Head, N. H	Feb. 2–May 25	Cod.
Marblehead, Mass	Feb. 25–Mar. 10	Do.
Plymouth, Mass	Nov. 1–Feb. 28	Cod and pollock.
Rockport, Mass	Nov. 1–May 25	Pollock, cod, and haddock.
Leadville, Colo.:		
Mount Massive Club Lakes, Colo	Oct. 22–Dec. 6	Brook trout.
Mount Princeton Lake, Colo	Nov. 14–Nov. 24	Do.
Turquoise Lake, Colo	Oct. 20–Dec. 5	Brook and Loch Leven trout.
Wurts Lakes, Colo	Sept. 24–Nov. 3	Brook trout.
Nashua, N. H.: Lebanon, N. H	Apr. 10–May 6	Rainbow trout.
Northville, Mich.:		
Beaver Island, Mich	Nov. 3–Nov. 30	Lake trout and whitefish.
Black River, Mich	Oct. 30–Oct. 31	Lake trout.
Cheboygan, Mich	Oct. 22–Nov. 7	Do.
	Nov. 23	Whitefish.
Cross Village, Mich	Nov. 19–Nov. 20	Do.
Epoufette, Mich	Nov. 7–Nov. 20	Do.
Frankfort, Mich	Nov. 17–Nov. 30	Lake trout.
Leland, Mich	Nov. 15–Nov. 30	Do.
Middle Island, Mich	Nov. 3	Do.
Naubinway, Mich	Nov. 17–Nov. 30	Do.
Northport, Mich	Nov. 15–Nov. 30	Do.
Oscoda, Mich	Oct. 27–Nov. 23	Lake trout and whitefish.
Presque Isle, Mich	Nov. 6	Lake trout.
St. Ignace, Mich	Oct. 22–Nov. 30	Lake trout and whitefish.
Sturgeon Bay, Mich	Nov. 17	Whitefish.
Put in Bay, Ohio:		
Catawba Island, Ohio	Nov. 9–Dec. 1	Do.
Middle Bass, Ohio	Nov. 9–Nov. 29	Do.
North Bass, Ohio	Nov. 9–Dec. 1	Do.
Port Clinton, Ohio	Nov. 9–Dec. 4	Do.
	Apr. 17–May 2	Pike perch and yellow perch.
	June 3–June 22	Carp.
Toledo, Ohio	Nov. 9–Dec. 2	Whitefish.
	Apr. 7–Apr. 30	Pike perch.

Egg-collecting stations—Continued

Station	Period of operation	Species handled
Saratoga, Wyo.:		
Big Creek Lakes, Colo	Sept. 4–Nov. 1	Brook trout.
Lost Creek, Wyo	Mar. 26–June 26	Rainbow trout.
Springville, Utah: Fish Lake, Utah	Oct. 6–Dec. 4	Brook trout.
	Apr. 1–May 31	Rainbow trout.
Woods Hole, Mass.:		
Groton, Conn	March to April	Cod and haddock.
Waquoit, Mass	January to April	Winter flounder.

SALVAGE OF FISH

The uncertainty attending the practice of rescuing fish from overflow areas, as of the upper Mississippi River, is well illustrated by the fact that the total collections for the year slightly exceeded 5,000,000, whereas under normal conditions 150,000,000 or more fish may be handled. Adequate rainfall throughout the summer permitted the river to recede slowly, allowing most of the fish to escape and rendering it unnecessary and impracticable to put the usual seine crews in the field. Such conditions occur at sufficiently frequent intervals to assure frequent restocking of the upper Mississippi with the entire output of these spawning areas and to replenish the drain occasioned by the extremely limited withdrawal of fish shipped to other waters by the bureau. The survey of the fish-cultural possibilities of the upper Mississippi River wild life and fish refuge was continued with the object of propagating warm-water fishes artificially and discontinuing the use of rescued fishes for general distribution.

Many organizations, being advised of the tremendous number of fish handled during a normal season of rescue work, have requested the delivery to other waters of bass and other species in carload lots. It has been necessary to refuse these requests in order to keep the withdrawals within reasonable limits. Further embarrassment has arisen from the fact that the public is unaware of the fluctuations in this source of supply and has assumed that it could be drawn upon at all times.

Number and disposition of fish rescued, fiscal year 1929

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
All stations:			
Buffalo fish		34,705	34,705
Carp		31,255	31,255
Catfish	1,020	834,322	835,342
Crappie	48,600	1,804,822	1,853,422
Fresh water drum		2,850	2,850
Largemouth black bass	1,445	4,357	5,802
Pike and pickerel		34,775	34,775
Pike perch		393	393
Sunfish	14,479	1,611,600	1,626,079
White bass		332	332
Yellow perch	6,650	110,648	117,298
Miscellaneous		660,000	660,000
Total	72,194	5,130,059	5,202,253
Summary, by stations:			
Fairport, Iowa		233,833	233,833
Homer, Minn	28,300	3,403,565	3,431,865
Lake Worth, Tex	25,000		25,000
Marquette, Iowa	18,894	1,492,661	1,511,555
Total	72,194	5,130,059	5,202,253

SHIPMENTS TO FOREIGN COUNTRIES

Shipments of eggs or fish to foreign countries during the year were somewhat below the number usually furnished. While the normal number of tentative inquiries relative to the possibility of acclimatizing American forms were received, they resulted in only the limited number of shipments appearing below. The bureau cooperated in handling some shad fry furnished by the State of Oregon for shipment to Japan. It is interesting to note that a consignment of smallmouth black bass fingerlings was successfully transported to Sweden. Certain shipments of eggs to Canada are not included, as these were involved in exchanges whereby the bureau received an equivalent number of salmon eggs.

Shipments of fish and fish eggs to foreign countries, fiscal year 1929

Country and species	Eggs	Fish	Country and species	Eggs	Fish
Canada: Rainbow trout	40,000		Sweden: Smallmouth black bass		250
Cuba: Rainbow trout	50,000		Switzerland: Lake trout	50,000	
Japan: Whitefish	3,000,000				
Peru: Rainbow trout	150,000		Total	3,290,000	250

PRODUCTION BY INDIVIDUAL STATIONS

The nature and magnitude of the activities at the various stations and substations is indicated in the ensuing table. The substations, which are not necessarily within the same territory as the main stations, occasionally being located in different States, are so designated for administrative reasons or on account of activity allied to that of the headquarters station. The number of main stations operated totals 37, while 40 substations were on an active basis.

Stations and substations operated and output of each, fiscal year 1929

[Asterisk (*) denotes transfer of eggs. See table, p. 779]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total [1]
Afognak, Alaska:				
Humpback salmon	1,851,550			1,851,550
Sockeye salmon			18,700,000	18,700,000
Baird, Calif.: Chinook salmon			711,000	711,000
Battle Creek, Calif.: Chinook salmon			2,189,000	2,189,000
Mill Creek, Calif.: Chinook salmon	*1,000,000		500,000	1,500,000
Baker Lake, Wash.: Sockeye salmon	(*)		63,500	63,500
Birdsview, Wash.—				
Brook trout			1,000	1,000
Chinook salmon		670,000	2,218,200	2,888,200
Silver salmon		1,875,400	268,890	2,144,290
Sockeye salmon			72,000	72,000
Steelhead salmon	90,000		760,000	850,000
Duckabush, Wash.—				
Chinook salmon			750,000	750,000
Chum salmon		11,541,000		11,541,000
Silver salmon		886,000	153,300	1,039,300
Quilcene, Wash.—				
Chinook salmon		50,000	693,000	743,000
Chum salmon		7,612,000		7,612,000
Silver salmon		1,420,540	148,000	1,568,540
Steelhead salmon			540,000	540,000
Sultan, Wash.—				
Chinook salmon		200,700	43,800	244,500
Silver salmon		1,362,100	50,000	1,412,100
Steelhead salmon		111,500	136,000	247,500

[1] Lost in transit, 30,780.

Stations and substations operated and output of each, fiscal year 1929—Continued

Asterisk (*) denotes transfer of eggs. See table, p. 779]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Berkshire trout hatchery, Mass.:				
Brook trout			256, 030	256, 030
Catfish			7, 060	7, 060
Boothbay Harbor, Me.				
Cod	1, 068, 142, 000			1, 068, 142, 000
Haddock	133, 577, 000			133, 577, 000
Winter flounder		2, 025, 822, 000		2, 025, 822, 000
Bozeman, Mont :				
Black-spotted trout			905, 180	905, 180
Brook trout			253, 930	253, 930
Golden trout			9, 000	9, 000
Loch Leven trout	*2, 775, 000		295, 480	3, 070, 480
Rainbow trout			916, 290	916, 290
Glacier Park, Mont.—				
Grayling		15, 000		15, 000
Rainbow trout	100, 200		375, 000	475, 200
Meadow Creek, Mont —				
Black-spotted trout	140, 000			140, 000
Grayling	(*)	1, 750, 000		1, 750, 000
Loch Leven trout	*4, 847, 700		120, 000	4, 967, 700
Rainbow trout	*575, 400		110, 000	685, 400
Cape Vincent, N Y.:				
Brook trout		321, 000	199, 500	520, 500
Catfish			300	300
Cisco	*9, 200, 000	116, 000, 000		125, 200, 000
Lake trout	357, 000	2, 431, 490		2, 788, 490
Loch Leven trout		5, 000		5, 000
Rainbow trout			74, 080	74, 080
Whitefish		22, 705, 000		22, 705, 000
Swanton, Vt.—				
Common sucker	1, 800, 000			1, 800, 000
Pike perch	28, 600, 000	16, 390, 000		44, 990, 000
Yellow perch		7, 700, 000		7, 700, 000
Watertown, N. Y.—				
Brook trout			427, 850	427, 850
Rainbow trout			95, 150	95, 150
Central Station, Washington, D. C.:				
Largemouth black bass			2, 100	2, 100
Brook trout			2, 400	2, 400
Chinook salmon		4, 000		4, 000
Cisco		1, 000, 000		1, 000, 000
Rainbow trout		20, 000	16, 150	36, 150
Sunfish			300	300
Fort Humphreys, Va.—				
Shad		64, 851, 000		64, 851, 000
Yellow perch		166, 023, 000		166, 023, 000
Lakeland, Md.—				
Largemouth black bass			13, 570	13, 570
Crapple			8, 400	8, 400
Sunfish			40, 150	40, 150
Clackamas, Oreg.:				
Black-spotted trout			20, 000	20, 000
Brook trout			69, 100	69, 100
Chinook salmon			4, 285, 000	4, 285, 000
Rainbow trout	15, 000		80, 400	95, 400
Silver salmon	505, 000			505, 000
Steelhead salmon			32, 500	32, 500
Applegate Oreg.—				
Chinook salmon			514, 600	514, 600
Silver salmon			778, 400	778, 400
Steelhead salmon	*1, 989, 000			1, 989, 000
Big White Salmon, Wash.—				
Black-spotted trout			8, 000	8, 000
Brook trout			254, 000	254, 000
Chinook salmon	5, 636, 000		7, 987, 500	13, 623, 500
Little White Salmon, Wash.—				
Chinook salmon	6, 883, 000		9, 940, 000	16, 823, 000
Chum salmon	765, 000		49, 000	814, 000
Rogue River, Oreg —				
Chinook salmon	1, 000, 000		2, 740, 000	3, 740, 000
Sockeye salmon			[1] 68, 000	68, 000
Salmon, Idaho—				
Chinook salmon			6, 477, 500	6, 477, 500
Rainbow trout			875, 500	875, 500
Cold Springs, Ga.:				
Largemouth black bass		103, 150	234, 700	337, 850
Catfish			5, 900	5, 900
Sunfish			87, 800	87, 800

[1] In addition to 25,000 fingerling sockeye salmon turned over to the State of Oregon in cooperative work

Stations and substations operated and output of each, fiscal year 1929—Continued

[Asterisk (*) denotes transfer of eggs. See table, p. 779]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Craig Brook, Me.:				
Atlantic salmon	345,000		572,200	917,200
Brook trout	(*)		1,542,500	1,542,500
Landlocked salmon	*110,000		311,470	421,470
Grand Lake Stream, Me.—				
Brook trout			199,150	199,150
Landlocked salmon			220,000	220,000
Green Lake, Me.: Landlocked salmon	(*)			
Duluth, Minn.:				
Brook trout			183,700	183,700
Cisco		6,000,000		6,000,000
Lake trout	197,000	13,001,000	[3] 775,000	13,973,000
Pike perch		12,760,000		12,760,000
Whitefish		1,300,000		1,300,000
Edenton, N. C.:				
Largemouth black bass		6,000	12,100	18,100
Crapple			450	450
Glut herring		11,500,000		11,500,000
Shad		6,500,000		6,500,000
Sunfish			40,250	40,250
Yellow perch		1,200,000	550	1,200,550
Weldon, N. C.: Striped bass (in cooperation with State)		9,661,000		9,661,000
Erwin, Tenn.:				
Largemouth black bass		30,500	3,800	34,300
Brook trout			332,400	332,400
Loch Leven trout			158,750	158,750
Rainbow trout	75,000		243,550	318,550
Rock bass			20,980	20,980
Sunfish			6,600	6,600
Fairport, Iowa:				
Largemouth black bass		11,700	47,200	58,900
Buffalo fish			28,300	28,300
Carp			23,750	23,750
Catfish			88,290	88,290
Crapple			73,200	73,200
Pike perch			400	400
Smallmouth black bass			4,200	4,200
Sunfish			40,300	40,300
Yellow perch			550	550
Gloucester, Mass.:				
Cod	1,159,980,000	274,033,000		1,434,013,000
Haddock	217,865,000			217,865,000
Pollock		358,442,000		358,442,000
Winter flounder		161,166,000		161,166,000
La Crosse, Wis.:				
Largemouth black bass			550	550
Brook trout	50,000		493,300	543,300
Catfish			160	160
Crappie			460	460
Loch Leven trout			168,100	168,100
Rainbow trout			318,600	318,600
Sunfish			2,800	2,800
Yellow perch			360	360
Bellevue, Iowa—				
Buffalo fish	44,100,000			44,100,000
Carp	24,300,000			24,300,000
Guttenberg, Iowa: Buffalo fish	5,296,000			5,296,000
Homer, Minn.—				
Largemouth black bass			2,900	2,900
Carp			1,000	1,000
Catfish			419,230	419,230
Crappie			842,000	842,000
Fresh-water drum			850	850
Pike and pickerel			12,480	12,480
Sheepshead			2,000	2,000
Sunfish			1,371,300	1,371,300
Yellow perch			108,500	108,500
Miscellaneous			660,000	660,000
Lynxville, Wis.—				
Largemouth black bass			680	680
Brook trout			9,600	9,600
Crappie			700	700
Sunfish			600	600
Marquette, Iowa—				
Largemouth black bass			1,300	1,300
Buffalo fish			6,450	6,450
Carp			6,500	6,500
Catfish			327,700	327,700

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[3] In addition to 18,000 fingerling lake trout turned over to the State of Minnesota in cooperative work.

Stations and substations operated and output of each, fiscal year 1929—Continued

[Asterisk (*) denotes transfer of eggs. See table, p. 779]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
La Crosse, Wis.—Continued.				
Marquette, Iowa—Continued.				
Crappie			922, 000	922, 000
Pike and pickerel			22, 300	22, 300
Sunfish			221, 600	221, 600
White bass			300	300
Yellow perch			3, 400	3, 400
Yellowstone, Wyo.—				
Black-spotted trout	*10, 402, 000		5, 898, 000	16, 300, 000
Leadville, Colo.:				
Largemouth black bass			2, 700	2, 700
Black-spotted trout			172, 500	172, 500
Brook trout	*850, 200		3, 635, 850	4, 486, 050
Loch Leven trout			173, 000	173, 000
Rainbow trout			207, 000	207, 000
Creede, Colo.: Rainbow trout			158, 000	158, 000
Louisville, Ky.:				
Largemouth black bass			2, 700	2, 700
Rock bass			1, 530	1, 530
Smallmouth black bass		531, 000	11, 060	542, 060
Sunfish			2, 130	2, 130
Mammoth Spring, Ark.:				
Largemouth black bass			144, 800	144, 800
Rock bass			15, 370	15, 370
Smallmouth black bass			116, 000	116, 000
Sunfish			31, 300	31, 300
Lonoke, Ark.: Largemouth black bass (in cooperation with State)			411, 000	411, 000
Manchester, Iowa:				
Largemouth black bass			1, 380	1, 380
Brook trout			568, 900	568, 900
Rainbow trout	*313, 300		224, 300	537, 600
Smallmouth black bass			3, 330	3, 330
Nashua, N. H.:				
Brook trout	10, 000	15, 000	276, 300	301, 300
Catfish			250	250
Landlocked salmon			9, 600	9, 600
Rainbow trout	10, 000		14, 100	24, 100
Smallmouth black bass		40, 000		40, 000
Neosho, Mo.:				
Largemouth black bass		32, 200	11, 850	44, 050
Crappie			5, 930	5, 930
Rainbow trout	*304, 000		218, 200	522, 200
Rock bass			11, 800	11, 800
Sunfish			6, 900	6, 900
Bourbon, Mo.: Rainbow trout	*1, 725, 000			1, 725, 000
Langdon, Kans.—				
Largemouth black bass			110, 100	110, 000
Carp			250	250
Catfish			33, 400	33, 400
Crappie			7, 300	7, 300
Rock bass			2, 900	2, 900
Sunfish			55, 000	55, 000
Yellow perch			5, 100	5, 100
Northville, Mich.:				
Brook trout			598, 100	598, 100
Landlocked salmon			2, 400	2, 400
Rainbow trout			252, 380	252, 380
Smallmouth black bass		72, 000	20, 100	92, 100
Alpena, Mich.—				
Lake trout	200, 000	[4] 618, 000	1, 276, 000	2, 094, 000
Whitefish	3, 000, 000	9, 700, 000		12, 700, 000
Charlevoix, Mich.—				
Lake trout	1, 430, 000	10, 049, 000		11, 479, 000
Whitefish		14, 608, 800		14, 608, 800
Orangeburg, S. C.:				
Largemouth black bass		129, 300	247, 400	376, 700
Catfish			1, 600	1, 600
Crappie			1, 400	1, 400
Sunfish			27, 760	27, 760
Warmouth bass			6, 470	6, 470
Put in Bay, Ohio.				
Carp		2, 500, 000		2, 500, 000
Pike perch		23, 000, 000		23, 000, 000
Whitefish		45, 981, 000		45, 981, 000
Yellow perch		18, 000, 000		18, 000, 000
Quinault, Wash.:				
Brook trout			1, 860	1, 860
Chinook salmon	(*)			
Silver salmon	*2, 100, 900			2, 100, 900
Sockeye salmon	*50, 200	2, 640, 000	988, 700	3, 678, 900

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[4] In addition to 240,000 lake-trout fry turned over to the State of Michigan in cooperative work

Stations and substations operated and output of each, fiscal year 1929—Continued

[Asterisk (*) denotes transfer of eggs. See table, p. 779]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
St. Johnsbury, Vt.:				
Brook trout	(*)	1,353,000		1,353,000
Landlocked salmon		14,500	260	14,760
Loch Leven trout			680	680
Steelhead salmon			1,030	1,030
Pittsford, Vt.—				
Brook trout			82,750	82,750
Rainbow trout			6,030	6,030
York Pond, N. H.: Brook trout	25,000	206,800	45,050	276,850
San Marcos, Tex.:				
Largemouth black bass			147,500	147,500
Crappie			12,040	12,040
Rock bass			2,330	2,330
Sunfish			46,000	46,000
Warmouth bass			250	250
Lake Worth, Tex.: Crappie			25,000	25,000
Medina Lake, Tex.—				
Largemouth black bass			25,740	25,740
Rainbow trout			20,060	20,060
Sunfish			700	700
New Braunfels, Tex.—				
Largemouth black bass			16,300	16,300
Sunfish			53,100	53,100
Saratoga, Wyo.:				
Black-spotted trout			238,310	238,310
Brook trout	*400,000	[5] 460,000	577,600	1,437,600
Loch Leven trout			119,000	119,000
Rainbow trout	(*)		335,250	335,250
Lost Creek, Wyo.: Rainbow trout	*700,000	605,000		1,305,000
Spearfish, S. Dak.:				
Brook trout	(*)		419,340	419,340
Loch Leven trout			217,100	217,100
Rainbow trout	(*)		211,500	211,500
Crawford, Nebr.—				
Largemouth black bass			500	500
Catfish			1,950	1,950
Sunfish			450	450
Springville, Utah:				
Brook trout	246,400		[6] 439,000	685,400
Rainbow trout	100,000		1,442,800	1,542,800
Tupelo, Miss.:				
Largemouth black bass		377,000	234,160	611,160
Catfish			1,880	1,880
Sunfish			110,560	110,560
Aliceville, Ala.—				
Largemouth black bass			19,350	19,350
Sunfish			14,200	14,200
White Sulphur Springs, W. Va.:				
Largemouth black bass			25,600	25,600
Brook trout	10,300		[7] 1,822,530	1,832,830
Loch Leven trout			[8] 244,570	244,570
Rainbow trout	777,200		[9] 979,810	1,757,010
Rock bass			6,600	6,600
Sunfish			16,200	16,200
Woods Hole, Mass.:				
Mackerel		2,778,000		2,778,000
White perch			250	250
Winter flounder	109,434,000	622,161,000		731,595,000
Wytheville, Va.:				
Largemouth black bass		6,000	8,990	14,990
Brook trout			[10] 214,500	214,500
Catfish			420	420
Rainbow trout			[11] 243,060	243,060
Rock bass			17,680	17,680
Smallmouth black bass		21,000	300	21,300
Yes Bay, Alaska: Sockeye salmon	4,530,000		34,284,720	38,814,720

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[5] Turned over to the State of Wyoming in cooperative work.

[6] In addition to 52,000 fingerling brook trout turned over to the State of Utah in cooperative work.

[7] In addition to 741,250 fingerling brook trout turned over to the State of West Virginia in cooperative work.

[8] In addition to 141,000 fingerling Loch Leven trout turned over to the State of West Virginia in cooperative work.

[9] In addition to 611,400 fingerling rainbow trout turned over to the State of West Virginia in cooperative work.

[10] In addition to 182,000 fingerling brook trout turned over to the State of Virginia in cooperative work

[11] In addition to 187,000 fingerling rainbow trout turned over to the State of Virginia in cooperative work.

TRANSFERS OF EGGS BETWEEN STATIONS

The adequate stocking of the various trout and salmon stations necessitates a widespread shipment of eggs from collecting stations and hatcheries that maintain brood stocks. A consignment of 100,000 trout or salmon eggs may be shipped by express across the continent at a negligible cost, whereas the transfer of fish requires the services of a special messenger with his attendant expenses or the movement of a fish car at 36 cents a mile. The following table illustrates the sources from which the bulk of egg supplies are obtained:

Transfer of eggs between stations, fiscal year 1929

Species	Number of eggs	From—	To—
Atlantic salmon	50, 000	Craig Brook, Me	Northville, Mich.
Black-spotted trout	566, 000	Yellowstone Park, Wyo	Bozeman, Mont.
	1, 000, 000	do	Glacier Park, Mont.
	300, 000	do	Leadville, Colo.
Brook trout	200, 000	Craig Brook, Me	Grand Lake Stream, Me.
	150, 000	do	Pittsford, Vt.
	500, 000	do	Nashua, N. H.
	50, 000	do	Northville, Mich.
	200, 000	Leadville, Colo	Do.
	100, 000	St. Johnsbury, Vt	Do.
	100, 000	York Pond, N. H	Craig Brook, Me.
	400, 000	do	Erwin, Tenn.
	5, 000	do	Pittsford, Vt.
	517, 000	do	St. Johnsbury, Vt.
	300, 000	do	Wytheville, Va.
	20, 000	Saratoga, Wyo	St. Johnsbury, Vt.
Chinook salmon	628, 000	Mill Creek, Calif	Baird, Calif.
	10, 000	Quinault, Wash	Central Station, Washington, D. C.
Cisco	1, 200, 000	Cape Vincent, N. Y	Do.
	400, 000	do	Nashua, N. H.
Grayling	25, 000	Meadow Creek, Mont	Bozeman, Mont.
Landlocked salmon	20, 000	Craig Brook, Me	Nashua, N. H.
	55, 000	do	Northville, Mich.
	25, 000	do	Pittsford, Vt.
	15, 000	do	St. Johnsbury, Vt.
	300, 000	Green Lake, Me	Craig Brook, Me.
Loch Leven trout	75, 000	Bozeman, Mont	Cape Vincent, N. Y.
	200, 000	do	Spearfish, S. Dak.
	4, 562, 000	Meadow Creek, Mont	Bozeman, Mont.
	50, 000	do	Crawford, Nebr.
	50, 000	do	Erwin, Tenn.
	400, 000	do	La Crosse, Wis.
	150, 000	do	White Sulphur Springs, W. Va.
Rainbow trout	1, 132, 000	do	Bozeman, Mont.
	600, 000	do	Glacier Park, Mont.
	25, 000	do	Neosho, Mo.
	344, 000	Manchester, Iowa	La Crosse, Wis.
	153, 000	do	Northville, Mich.
	22[illegible], 000	Neosho, Mo	Bozeman, Mont.
	25, 000	do	Meadow Creek, Mont.
	105, 000	do	Northville, Mich.
	25, 000	Bourbon, Mo	White Sulphur Springs, W. Va.
	223, 000	Lost Creek, Wyo	Saratoga, Wyo.
	100, 000	White Sulphur Springs, W. Va	Barneveld, N. Y.
	44, 000	do	Central Station, Washington, D. C.
	500, 000	do	La Crosse, Wis.
Silver salmon	[illegible]94, 000	Quinault, Wash	Clackamas, Oreg.
	1, 607, 000	do	Hoods Canal stations, Wash.
Sockeye salmon	50, 000	Baker Lake, Wash	Birdsview, Wash.
	723, 000	Quinault, Wash	Hoods Canal stations, Wash.
	49, 000	do	Rogue River, Oreg.
Steelhead salmon	100, 000	Applegate Creek, Oreg	Big White Salmon, Wash.
	200, 000	do	Clackamas, Oreg.
	806, 000	do	Rogue River, Oreg.
	25, 000	do	St. Johnsbury, Vt.

GENERAL FISH-CULTURAL NOTES

NEW STATIONS

One new station, located at Crawford, Nebr., was placed on a producing basis during the year. Although the hatchery building was not completed at the close of the year, a number of trout fingerlings, which had been transferred from the Spearfish (S. Dak.) station, were distributed during the spring. These fish had been reared in ponds constructed on the Fort Robinson Military Reservation. Work completed at the close of the year included, in addition to these ponds, a foreman's dwelling and combination shop and garage, which, with minor improvements to the grounds, gave the bureau a very creditable plant.

Work at the Valdosta (Ga.) pond substation was impeded by difficulty encountered in securing drainage by means of drilled wells tapping a subterranean drainage passage. During the progress of this drilling two dwellings were constructed, pipe lines were laid, roads constructed, and fences erected. It has been possible to introduce a brood stock of bass and bream, and a limited output is expected during the fall of 1929.

Little additional work was accomplished at the Fort Worth (Tex.) substation, but all ponds were stocked with brood fish, and prospects indicate a satisfactory hatch, which is being held for fall distribution. Sufficient land was finally acquired to permit the development of the Tishomingo (Okla.) pond station, and at the close of the year plans were being drawn for immediate construction of a dwelling and dam for the water supply.

At Creede, Colo., work on the new trout substation consisted in the construction of a reservoir, into which the spring water supply was conducted by tile laterals. Excavation for the main pipe line was completed, a complete survey of the tract was made, and the heavier construction work to be undertaken immediately after July 1, was laid out.

At Yellowstone Park a splendid new log hatchery was erected and lacks only the installation of troughs and other equipment. The building has facilities for an aquarium and for the demonstration of fish-cultural work for the benefit of the many visitors. Construction of a bunkhouse and mess house of a similar type of architecture was well under way at the close of the year. When completed the bureau will have a highly efficient fish-cultural plant here and one especially in keeping with the surroundings. In addition to these activities, ten 60-feet rearing ponds were constructed at Mammoth Hot Springs, waste water from a power house constituting the water supply. These ponds will be operated until October, permitting the distribution of a large number of fingerlings in place of the advanced fry that have been handled in the park work hitherto. The Glacier Park hatchery has likewise been equipped with a series of rearing ponds with the same object in mind. Additions to both the Saratoga (Wyo.) and Springville (Utah) stations have increased materially the rearing capacity of these plants.

FISH FOODS

At a number of stations trials of various fish foods have been under way on an experimental basis. The most promising results were secured at the Bozeman (Mont.) station, which has been feeding a dried liver-meal preparation and a dried material derived from salmon eggs. This station reared a large number of fingerlings with unusual success, and part of the credit for the results was ascribed to the new diet. Dried buttermilk is now a regular article of diet at several of the trout stations.

TRANSFER OF SPINY LOBSTERS

Near the close of the fiscal year a shipment of adult female and male spiny lobsters was transported from Key West, Fla., to Galveston, Tex., for planting on the jetties at that point. The consignment was sent by steamer in large tanks and was accompanied by an employee of the bureau to supervise planting. Observations will be made to learn whether the crustaceans will become established in this new environment.

EARLY SPAWNING OF BLACK-SPOTTED TROUT

For several years the bureau has received reports that black-spotted trout were spawning in February and March in Glacier National Park. Accordingly, in March the foreman of the Bozeman (Mont.) station investigated the situation in Logging Lake. Ripe males and females with mature eggs were found in the lake under thick ice, and it was demonstrated that this unusual aberration in the spawning habits of the species actually exists. Inasmuch as eggs of this species in this latitude are generally taken not later than May or June, it is obvious that an egg supply from such early spawners would be of material benefit. Since weather conditions require the planting of the fish in the early fall in high altitudes, the collection of eggs in February or March would permit the distribution of good-sized fingerlings in place of fish that are little more than advanced fry. Efforts will be made to develop Logging Lake as a source of eggs.

COMMERCIAL SPECIES

The collections of eggs and the resultant distribution of fish throw a significant light on the status of the commercial fisheries. The past season's work showed a maintenance of earlier levels or an increase in the marine and anadromous forms on both coasts. In the interior waters, especially the Great Lakes, a recession was evident. It is to be assumed from such a situation that the basic resources in the coastal areas are so extensive as to permit natural recuperation from the drain arising from the fisheries. It may be judged that the same or more intensive efforts applied to the fisheries of the interior waters, with their limitations of area, are depleting basic stocks in a few instances, and that artificial propagation is not able to overcome the reduction. Again emphasis should be placed on the fact that the propagation of some forms, such as cod, haddock, pollock, shad, and striped bass, is truly a by-product recovery, in that the hatchery eggs are secured from fish caught for market prior to the full exercise of their reproductive functions.

PACIFIC SALMONS

In spite of an unsatisfactory season with the chinook salmon in California, the aggregate production was brought above that of last year by an increased output of sockeye salmon. The virtual destruction of the sockeye run in Baker River, Wash., by the construction of a high dam forced a sharp curtailment in the operations of the Baker Lake hatchery. At the Columbia River stations extensive marking experiments, designed to show the effectiveness of artificial propagation, have been continued.

Afognak (Alaska) Station

[Frank L. Snipes, Superintendent]

During the year the telephone line between the station and the cannery building was rebuilt. The escapement of sockeye salmon to Letnik Lake exceeded 20,000, and from less than 8,000 females that spawned over 20,000,000 eggs were secured. The hatch was above 90 per cent. As usual, the fingerlings were liberated in Letnik Lake and its tributaries. At the close of the fiscal year over 14,000 salmon were being held in the lake, with a very satisfactory collection of eggs in prospect. An attempt to trap downstream migrants was made in May, but high water prevented the effective operation of the trap. During the fall 2,300,000 humpback-salmon eggs were collected, the majority of which were transferred to the State of Washington. Arrangements have been made for the construction of a road from the station to Letnik Bay by the Department of Agriculture.

Yes Bay (Alaska) Station

[A. T. Looff, Superintendent]

Quite extensive repairs and improvements to the station buildings and equipment were made during the year. The first step toward rebuilding the pipeline trestle was completed with the renewal of the high 450-foot section of the trestle. The 350-foot flume carrying the water supply from the pipe line into the hatchery building was reconstructed. The rebuilding of the station tramways, which has been in progress for the past three years, was completed with the renewal of the 1,500-foot tramway extending from the boathouse to the pipeline trestle. All station walks were rebuilt. The rack apron was repaired successfully, and a new set of rack horses and picket sections was constructed. The exterior surface of several buildings and the roofs of all buildings were painted. New foundations and floors were put in the dynamo and feed room in the hatchery building. The bunk house, three cottages, and the mess house were repapered. The outdoor toilet of the lower bunk house was rebuilt and a flushing system, together with sewage pipe line to the river, installed. A new float was built for the landing at Back Bay.

Sockeye-salmon fingerlings to the number of 16,284,715, carried over from the previous year, were planted as fingerlings No. 1 in July. Spawn-taking operations in August and September resulted in the collection of 24,036,000 sockeye eggs, of which 2,493,000 were shipped away from the station on reaching the eyed stage. Of the remaining eggs, 20,779,500 were hatched and successfully carried through the yolk-sac absorption period. All of these fish were held in the station ponds and fed until May, when 5,000,000 were planted as fingerlings No. 1; 10,000,000 of the same size and 3,000,000 fingerlings No. 2 were planted in June; and at the close of the fiscal year 2,440,000 fingerlings No. 2 were still on hand in the ponds. Early in September a sufficient number of humpback-salmon eggs were collected to furnish a shipment in excess of 2,000,000 eyed eggs for transfer to the Washington State Fish and Game Commission. On the 11th of June 150,000 eggs were taken from a small run of steelhead salmon intercepted by the station trap and were on hand as eyed eggs at the close of the year.

Baker Lake (Wash.) Station and Substations

[Joseph Kemmerich, Superintendent]

Operations in this field were conducted at five permanent stations. The steelhead trout and all of the Pacific salmons, excepting the humpback, were propagated. A recession in numbers marked the activities with all varieties, with the exception of steelhead trout. The total collection of eggs of all species amounted to 30,393,800, which was some 13,000,000 below the total of the previous year. A number of streams were investigated with the object of determining whether it would be possible to establish a run of salmon therein or to utilize them as bases for fish-cultural operations. As in previous years, a close inspection was maintained over the working of the power dam in the Baker River at Concrete to determine the value of the fish ladder installed. A negligible number of sockeye salmon was put over the dam by artificial means, with the result that the activities of the Baker Lake station were restricted still further.

Baker Lake (Wash.) station.—The traps were installed in Baker Lake very early, but only 895 sockeye salmon and a very small number of silver salmon were taken. The eggs secured from the former species amounted to 661,000, most of which were hatched and the product reared for distribution as fingerlings in Baker Lake. It was noted that a run of landlocked sockeye salmon has become established apparently due to the creation of a large artificial lake in Baker River.

Birdsview (Wash.) substation.—A new dirt pond was constructed for the purpose of holding adult fish prior to spawning. A new water-supply dam and headgate were constructed in Grandy Creek, replacing the old ones, which were washed out by high water. The feeding of young salmon and trout to the full capacity of the station was again carried on during the spring. Considerable trouble was experienced among the sockeye fingerlings due to the pop-eye disease. Low water in Grandy Creek resulted in a poor run of chinook and silver salmon, with a consequent reduction in the number of eggs secured. A number of eastern brook trout also were handled.

Duckabush (Wash.) substation.—A new permanent trap was constructed in the Duckabush River. Shortly after its installation, however, unusually high water washed out the abutment, necessitating immediate repairs pending its permanent reconstruction. A new water-supply flume was likewise constructed. The old decayed rack in the creek near the station was torn out and a new permanent rack built. The old water-supply flume, which had become unsafe, was replaced by a new one extending from the intake dam down to the settling tank. The run of chum salmon in the Duckabush River was very large, and the collection of 10,000,000 eggs does not represent more than half of the number available had there been sufficient room to handle them. The station also collected a large number of eggs of the late chum salmon from the Walcott Slough trap. Shipments of chinook salmon eggs were received from other stations, and the resulting fingerlings planted in local waters in the hope of establishing a run. The run of silver-salmon eggs was below normal, and the shortage of eggs was further emphasized by the defective traps, which allowed the escape of many of the brood fish. A few steelhead eggs also were secured.

Quilcene (Wash.) substation.—Some remodeling and enlargement work was completed on the living quarters of the station. Eggs of the chum salmon, silver salmon, and steelhead were collected at the station, and chinook and silver-salmon eggs transferred from other points were handled also. Four and one-half million chum-salmon eggs were transferred to Quilcene from the Duckabush station because of a water shortage at that point. In common with all the other stations in the field, the collection of silver-salmon eggs was below normal.

Sultan (Wash.) substation.—High water in Elwell Creek apparently damaged the trap, necessitating temporary repairs. Very few chum salmon were caught in the trap, and most of the eggs obtained for the station were secured through trapping operations farther downstream. Low-water stages in the creek at the height of the silver-salmon run resulted in a limited collection of eggs of that species. Conditions were favorable during the spring for a good collection of steelhead eggs.

Quinault (Wash.) Station

[Marcus S. Meyer, Superintendent]

While eggs of the different species of Pacific salmon are handled in this field, the principal activities of the station are concerned with the propagation of the sockeye salmon. During the fall spawning season, extending from October 23 to December 14, eggs of this species to the number of 5,840,000 were collected, together with 5,100,000 of the silver and 65,000 of the chinook salmon. These results were accomplished despite the very unfavorable weather conditions, all streams of the region being at such a low stage practically throughout the fishing season as to cause large numbers of fish to spawn in the lower Quinault River or along the shores of Quinault Lake. After developing the eggs to the eyed stage a number of shipments were made to State hatcheries in Washington and Oregon and to other stations of the bureau. The fry produced from the remainder of the stock were distributed in the station ponds during the spring, with the intention of holding them for several months before liberating them in Quinault Lake.

In the course of the fiscal year a 7-room dwelling for the superintendent was completed and a small building equipped with an underground gasoline storage tank was constructed for the safer storage of gasoline. The interiors of two of the station dwellings were painted and papered. In advance of the transfer of young salmon the station ponds were drained and the bottoms and sides painted with asphaltum paint to serve as a check against the too profuse development of algæ.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS

[PHILO B. HAWLEY, Superintendent]

The egg collections at the Oregon group of stations for the year amounted to approximately 52,570,000, or 4,296,000 less than were secured last year. The usual efforts were made to obtain eggs from the chinook and silver salmons and the steelhead and rainbow trout, and an attempt was made to collect eggs of the chum salmon in the Little White Salmon field.

Clackamas (Oreg.) station.—In the course of the year three new concrete ponds for the exhibit of goldfish were constructed, and minor improvements to station roadways, buildings, and equipment were made. The covering of the rearing pools by a growth of vines over a pipe framework has proven very successful. The season's collection of chinook-salmon eggs in the Clackamas River proved an entire failure, the reason advanced being the pollution of the Willamette River. A number of chinook-salmon eggs were transferred from the substations, including 1,400,000 from the Big White Salmon field and over 2,000,000 from the State of Oregon. The eggs at the upper Clackamas substation also were developed here. The fingerling chinook salmon and steelhead trout on hand at the beginning of the year were liberated. A number of rainbow-trout eggs were incubated, and a small shipment of black-spotted trout eggs was received from Montana. Half of these were immediately transferred to the Big White Salmon hatchery, and the fingerling fish resulting from the remainder were distributed locally. Eastern brook trout, silver trout, and steelhead salmon also were handled.

Little White Salmon (Wash.) substation.—A large cold-storage plant was under construction at this substation at the close of the year. The purpose of this building is to freeze and store large quantities of spawned-out salmon for use as fish food. Considerable attention was given to the repair of the water-supply flume, which will require replacement in the near future. The year's collection of chinook-salmon eggs was somewhat below that of an average season, the shortage amounting to approximately 6,000,000. Practically 10,000,000 were transferred to other stations. A very successful percentage of hatch was attained by means of the stacked-tray system. The young fish were fed on horse meat and spawned-out salted salmon, about 70 barrels of the latter being used.

Big White Salmon (Wash.) substation.—Two earth rearing ponds for trout were constructed and several of the salmon-rearing ponds in upper Hatchery Creek were enlarged. A new concrete dam also was installed in one of the upper ponds of this series. A section of the main water-supply pipe crossing the railroad track was replaced with a new line and other minor items of upkeep and repair received attention. Chinook-salmon egg collections at this point were approximately normal, over 15,000,000 being secured. These eggs were transferred from the collecting points to the hatchery by motor truck immediately after hardening. Over 6,000,000 eggs were shipped and some 7,500,000 fry resulting from the remainder were retained for rearing and subsequent liberation in the Columbia River. Extensive marking experiments, utilizing over 150,000 fingerlings, were carried on from May to the following March. The station also handled some brook-trout fingerlings and 125,000 black-spotted trout eggs for the account of the State of Washington. Limited numbers of rainbow-trout and steelhead-trout eggs likewise were incubated, and the resulting fry were distributed for the State.

Rogue River (*Oreg.*) *substation.*—A new electric pump was installed to provide a water supply for the rearing ponds. Fishing for chinook salmon commenced somewhat in advance of the usual time, and over 4,000,000 eggs were secured, with the possibility of obtaining a million additional had incubating facilities been available. Approximately 500,000 of these were shipped to other points, and the fingerlings resulting from the remainder were liberated near the close of the year. A few sockeye salmon and steelheads were transferred from other points, and a number of fingerlings of both species were on hand at the close of the year.

Applegate Creek (*Oreg.*) *substation.*—Approximately 500,000 spring chinook-salmon eggs were transferred from the McKenzie River hatchery of the Oregon Fish Commission with the object of establishing a run in local waters. Some trouble was experienced in rearing the fry, due to the cold water. The collection of silver-salmon eggs was limited, amounting to only about one-third of the previous season's take. A collection of steelhead-trout eggs to the number of 5,500,000 represents the largest season's total at this station for a number of years. Approximately one-half of them were shipped to other points, and 1,700,000 of the resulting fingerlings were on hand at the close of the year after making heavy plants of the species in Applegate Creek.

Salmon (*Idaho*) *substation.*—At the beginning of the year almost 900,000 rainbow-trout fry obtained from the new egg-collecting station at Williams Lake were on hand. These were liberated at various points during the year. The collection of chinook-salmon eggs in the Lemhi River was somewhat less than that of the previous year. A shipment of 3,000,000 of these eggs was also received here from the State of Oregon to be incubated and the product utilized for stocking local waters. The spring collection of rainbow-trout eggs in the Williams Lake field was slightly below that of the previous spring due to unfavorable weather conditions.

BAIRD (CALIF.) STATION AND SUBSTATIONS

[W. K. HANCOCK, Superintendent]

The work at the main station was carried on very much the same as last year. The racks were installed at the usual time, but for some reason the run of salmon in the McCloud River was light. Only 200,000 eggs were collected from the spring run. It was thought best to try for the fall run again, so the racks were left in until the late run was over. Only 50,000 eggs were collected, however. There being no gravity water in the hatchery, this small lot of eggs was held in outside batteries until the arrival of the 1,000,000 eggs transferred from the Mill Creek substation. From the combined lots 1,211,000 fingerling salmon were developed and planted in the Sacramento River, and in order to get below the head of a large irrigation canal the fish had to be hauled about 20 miles. During the year portions of all the buildings were painted and a number of cement walls were poured, materially improving the appearance of the grounds around the buildings. Two new settling ponds were constructed near the garage. Four or five rearing boxes were made and floated in the river below the upper rack for holding fish after the gravity ditch failed, and the only means of obtaining a hatchery water supply was by pumping. The floating boxes worked very satisfactorily, and it is likely that more of them will be used next season.

Battle Creek (*Calif.*) *substation.*—The fall collection of chinook-salmon eggs was light, totaling 2,347,000. About 98 per cent were hatched, and 2,189,600 fingerling fish were produced and planted in Battle Creek near the substation. It has been the practice for several years past to seine the main river in search of brood fish, but an unfortunate delay in installing an engine in the boat needed for the work made it impossible during the past season, as the larger portion of the run had spawned before operations could be undertaken, and the few that had not spawned could not be captured in the high water prevailing at the time. While engaged in placing racks in the creek a driveway was connected to the lower side of the structure as a convenience in crossing the stream. A 30-foot tower was built, an old tank formerly used at Baird station was set up, and a small centrifugal pump and water tower were installed for irrigating the station grounds.

Mill Creek (*Calif.*) *substation.*—The work was carried on as in past years. The run of salmon was light and the collection of eggs below the average take. A storm in November damaged the racks, allowing many of the salmon held below to pass up the creek. Of the 2,350,000 eggs secured, 1,000,000 in the eyed stage were transferred to the main station. The remainder were hatched at the point of collection, and the output amounted to 1,312,000 fingerlings. All of these were planted early in the spring, due to cessation of the station water rights at that time.

FISHES OF THE GREAT LAKES

While a marked decline was evident in the output of three important species, the whitefish, lake trout, and pike perch, it is only in the case of the former that there is real evidence that a shortage of fish was responsible. Local weather conditions can be definitely ascribed as the cause of the decline in the other species. There were obtained a large number of cisco or lake herring eggs, further illustrating the fluctuations that take place in the propagation of this form. Adverse weather likewise affected unfavorably the operations with carp and yellow perch during the spring. Where it is difficult to secure increased quantities of eggs the efficiency of the activities may be improved by bettering the quality of the eggs, since the percentage of hatch with the species included in this group is usually low enough to admit of considerable increase.

Duluth (Minn.) Station

[Ward A. Cook, Superintendent]

Arrangements were made early in the fall for the collection of lake-trout and whitefish eggs at the various Lake Superior egg-collecting ports formerly occupied; and between September 28 and November 2 eggs of the former to the number of 20,702,000 were secured, of which a surplus of 167,000 in the green stage was turned over to the Minnesota State hatchery at French River. Previous plans made for securing whitefish eggs around Munising, Mich., could not be carried out owing to the heavy storms prevailing during the spawning period. Collections of this species were therefore confined to the area in the vicinity of Isle Royale, and the take of eggs was light, amounting to only 1,480,000. After partial development in the Duluth hatchery, 30,000 of the eyed lake-trout eggs were transferred to the Leadville station with the view of completing incubation there and supplying the resulting young fish to a Colorado applicant. With the exception of a few small shipments of fingerlings, utilized for stocking inland waters in the surrounding region, the entire output of fry and fingerling lake trout and whitefish was returned to the native spawning grounds around Isle Royale and along the southern shore of Lake Superior.

From a shipment of 250,000 eyed eggs received from Colorado late in November the station produced 170,000 fingerling brook trout, all of which were distributed to applicants in northern Michigan, Wisconsin, and Minnesota. Approximately 25,000,000 cisco (lake herring) eggs were collected during November at Bayfield, Wis. Owing to the extremely unfavorable conditions under which they were secured, they were of very inferior quality, and a hatch of only 5,000,000 fry resulted. One small lot of these eggs, taken from a skiff fishing near the shore in the vicinity of the station, were of such high grade that the loss in hatching was merely nominal. Through cooperative collections with the Minnesota Game and Fish Department at Bemidji, Minn., the station acquired 30,100,000 green and 4,900,000 eyed pike-perch eggs. Though the losses on the green stock were heavy, a sufficient number of fry were produced to fill all requirements for pike-perch fry in the Minnesota field. In the course of the year the old worn-out station boiler was replaced by a new one of 25 horsepower of the Leffel Scotch marine type.

Northville (Mich.) Station and Substations

[W. W. Thayer, Superintendent]

The number of brook and rainbow trout eggs handled at the main station amounted to 1,591,750, or about 500,000 less than were acquired the previous year. All of the resulting fry were reared to the fingerling stage and were then delivered to applicants in Michigan, Indiana, and Ohio, and to the cooperative nurseries operating in conjunction with the Northville station. During the spring 2,500 landlocked salmon were hatched and turned over to an applicant at Alpena, Mich. The smallmouth bass were just as disappointing as last year. About 70 fish, enough to stock one pond, were carried through the winter. A shipment of adult smallmouth bass from the Lake Erie field suffered heavy loss en route, and all of the survivors died within a few days after being placed in the station ponds. The output of fish from one pond amounted to slightly over 90,000, delivered to applicants in Michigan, Indiana, and New Jersey, and 20,000 fingerlings were estimated to be in the pond at the close of the year. The stock of adult bluegills, about 35 in number, was transferred last fall from pond R, where they had been kept previously, to pond N. This pond has never produced many bass, and it was believed that the bluegills would do better in a pond used exclusively for that species. To the 35 adults available were added about 125 yearling fish taken in traps in the creek running across the reservation. At the close of the year the fish were spawning and the indications pointed to a good output of fingerling fish later in the season.

About 100 loads of mud were hauled from four of the bass ponds to facilitate removal of fish. The retaining wall along the creek crossing the reservation was repaired in several places and is now in good condition. A new wall was built at the north side of pond K, and two cement ponds were rebuilt. The hatchery and residence were shingled and the residence was repaired, so that now it is a modern dwelling. All troughs, trays, etc., were given a heavy coat of asphaltum varnish, and repairs were made to fit them for use. Two Leach hatching troughs were made and used during the season.

Alpena (Mich.) substation.—The first whitefish eggs were received on November 5, and a total of 21,880,000 was handled until the closing of the season on December 1. A shipment of 3,000,000 whitefish eggs was made to the Japanese Government. Material assistance was received from the State game wardens and hatchery officials during the egg-collecting season. Twenty-five quarts of eggs of poor quality were received from Sturgeon Bay on Lake Michigan. It is believed that many tons of whitefish were caught by the fishermen from which few or no eggs were secured. A close supervision of fishing operations would be desirable to prevent this waste. The resulting fry were planted on the various fishing grounds. Catches of whitefish were reported as poor, but large numbers of immature fish were seen in Thunder Bay.

The first test nets for lake trout were set on October 18. Up to December 1, the close of the season, over 17,000,000 eggs were received, somewhat above the average in quality. The resulting fry were moved to outside ponds in the spring because of a scarcity of boats for distributing them. The resulting overcrowding caused considerable loss. Two nursery ponds were maintained near by, and 800,000 fingerlings were placed in them for rearing. One of the station employees was detailed to take charge of the nursery and attend to the feeding, etc. One thousand and seven hundred quarts of pike-perch eggs were taken during the spring and turned over to the State hatcheries. These lots were low in fertility.

Under a special appropriation there was constructed a 5-room cottage for the apprentice fish-culturist. A cement floor was laid in the hatchery, and two new whitefish batteries as well as 36 trout troughs were constructed. The unprecedented high water during the past year has undermined the shore line, and there is a possibility of considerable damage being done to the property if protective cribbing is not erected.

Charlevoix (Mich.) substation.—This station handled a smaller number of lake-trout and whitefish eggs than usual, the total of both species being only about 43,000,000. The falling off was due in part to rough weather during the spawning season and also to lack of fishermen to take all eggs available. The percentage of eyed eggs was somewhat better than in the previous year, but it was necessary to employ extra egg pickers in order to keep the eggs clean and prevent their being killed by fungus. It is believed that if a number of experienced spawn takers were available for detail to the Charlevoix station during the spawning season a larger number of eggs could be collected and a high percentage of fertilization attained. Good fertilization and proper handling of the eggs in the field would lighten the work and reduce the expense of operations.

During the summer of 1928 the hatchery was painted inside and minor repairs were made. The cottage was painted inside during the fall, and the work of painting the exterior of the hatchery was begun toward the end of the year. The aquaria room was put in shape for the summer season and is attracting considerable attention. Rainbow, brook, Loch Leven, and lake trout, yellow perch, a rock sturgeon, a rock bass, and a few fancy goldfish have been obtained for the exhibit.

In the course of the winter material was purchased and racks made for installing a trap in Boyne River for the purpose of collecting steelhead eggs. The trap was put in on April 10 but later was moved down the river about three-fourths of a mile, as it was discovered that fish were not running up to the trap but were spawning farther downstream. In its new location the trap was hard to hold on account of water washing under the racks and permitting the fish to escape up the river. The work was a failure so far as egg collections were concerned, but the experience gained should be valuable in another season. The trap was also bothered by poachers and all of the fish being held in it were speared and taken out.

Put in Bay (Ohio) Station

[David Davies, Superintendent]

Shortly after the 1st of November arrangements were made with the commercial fishermen to collect whitefish eggs, and on the 9th of that month station employees equipped with the necessary collecting outfit were detailed at the various field stations occupied last year to receive eggs and forward them to the hatchery. The spawning season, which extended from November 15 to December 10, proved a very discouraging one, the work being handicapped by a great shortage of fish at all points. Only 66,640,000 eggs were secured, this total constituting the smallest year's collection of whitefish eggs in Lake Erie since 1899. Equally discouraging conditions were encountered during the following spring in the pike-perch work. Not only were the catch of fish and the daily egg collections much lighter than in recent years but the comparatively few eggs secured were of such inferior quality that only 23,000,000 fry resulted from a collection of 121,800,000 eggs. Incidental to the pike-perch work 20,750,000 yellow perch eggs were obtained and hatched with only normal loss. Due to the high water prevailing in June in Sandusky Bay and Portage River, the carp work was almost a failure, the only results being 3,750,000 eggs collected and 2,500,000 fry hatched. In addition to the propagation work outlined above, the Put In Bay station collected 569 adult smallmouth bass in Lake Erie for use as a brood stock at other stations of the bureau.

During the year extensive repairs and improvements were made to the station steamer *Shearwater*, which was then turned over the division of scientific inquiry for use in investigation work. The station gas boat was repaired and painted, and considerable repairs were made on the wharf in front of the hatchery. Old paint was removed from the walls of the hatchery room, boiler room, office, kitchen, and bath and toilet rooms at the residence and replaced with new paint. New window sash were placed in the attic of the residence, and the roof of the storehouse was shingled. The tin roofs of the annex building and the porches of the residence were repaired and painted. All large field egg cases were repaired, painted, and stenciled. Repairs were made on the station boilers and pumps.

Cape Vincent (N. Y.) Station and Substations

[J. P. Snyder, Superintendent]

The damage caused by two unusually severe storms and the highest water level in the St. Lawrence River since 1889 necessitated extensive repairs to the station docks. One of the garages was enlarged to provide room for an additional truck, all buildings and boats were painted, and the lawn and flower beds were improved. The collection of lake-trout eggs was the second largest in the history of the station, but, due largely to adverse weather, the holding of trout in pens to ripen was not as successful as in the preceding fall. No trouble was experienced in keeping the fish alive and in good condition, and the eggs taken from them were of high quality, but, because of storms, only a limited number of brood fish could be obtained. The collection of whitefish eggs exceeded that of the previous year by 13,692,000, while the take of cisco eggs was in excess of last year's to the extent of 44,340,000. A total of 1,091,458 brook-trout and 75,000 Loch Leven trout eggs was received in exchange for other eggs, and all fry from these, with the exception of 181,000 distributed in New York State, were assigned to the station's field and cooperative nurseries. In addition to the Watertown and Barneveld substations, the Cape Vincent station supervises the work at five cooperative nurseries, located at Averill, Vt., Malone, N. Y., Adams, N. Y., Oneonta, N. Y., and Arena, N. Y. The combined output from these nurseries during the year consisted of 8,595 18-months-old brook-trout from 5 to 12 inches long and 71,500 brook-trout fingerlings Nos. 2 and 3.

Watertown (N. Y.) cooperative substation.—This project comprises 84 nursery troughs, a cottage, a garage, and a meat house. In addition to handling 110,000 trout in cooperation with the Jefferson County Fish and Game Association and the French Lake Development Association, the bureau produces independently each year about half a million fingerling trout. The output from this nursery in 1928 was as follows:

Brook-trout fingerlings	401, 650
Rainbow-trout fingerlings	95, 150
Brook-trout fingerlings produced in cooperative work	84, 000
	580, 800

There were on hand at this substation at the close of the fiscal year 608,960 brook-trout and 34,000 Loch Leven trout fingerlings.

Barneveld (*N. Y.*) *cooperative substation.*—This nursery is operated throughout the year in cooperation with the Utica Chapter of the Izaak Walton League, and its output for the year was 4,675 brook-trout and 74,075 rainbow-trout fingerlings Nos. 2 and 3. There were on hand at the end of June, 1929, a total of 2,649 yearling brook trout and 9,970 yearling rainbow trout, also a total of 174,770 brook-trout and 77,600 rainbow-trout fingerlings.

Swanton (*Vt.*) *substation.*—Adverse weather conditions caused serious trouble, not only in connection with the propagation of pike perch but involved considerable damage to the plant. The foundation walls of the boathouse and the canal walls to the fish pens required extensive repairs. The excessive wash along the the lake shore was counteracted by driving willow posts and distributing rock and gravel. Unseasonably warm weather during March caused the pike perch to begin their spawning migration unusually early, but ice in the lake prevented the setting of nets until April 7. Notwithstanding the poor catches of pike perch in the trap nets, a total of over 4,500 brood fish was taken and penned, this aggregate being appreciably larger than that of the previous year. For some reason the eggs matured very slowly, and by May the condition of the fish necessitated their release. Up to that time only 940 female pike had spawned, yielding approximately 70,000,000 eggs. The eggs taken were distributed in accordance with the existing cooperative agreement, part of them going to the State of Pennsylvania. The remainder were incubated in the Swanton hatchery and the resulting fry distributed to the credit of the bureau and the State of Vermont. Efforts were made to collect yellow-perch eggs. When about 7,000,000 had been secured and many more were available a heavy storm destroyed and scattered the masses, so that subsequent collections were negligible. The majority of the fry hatched were planted in Vermont waters or returned to Lake Champlain. A few eggs of the white sucker were collected and turned over to the State of Pennsylvania.

RESCUE OPERATIONS

The activities in connection with the salvaging of stranded fishes from overflowed areas along the Mississippi River, administration of the fisheries phases in the upper Mississippi River wild-life and fish refuge, supervision of the Mississippi Valley, middle western, and intermountain hatcheries, as well as temporary field work, such as the collection of trout eggs in Yellowstone Park and the propagation of buffalo fish, are directed from headquarters at La Crosse, Wis. A more or less mobile organization, which operated in sections as divergent as Arkansas and Montana, has been developed for this work. Weather conditions rendered the salvaging of fish unnecessary and virtually impossible during the year, and the efforts of the personnel were directed toward their other duties.

La Crosse (Wis.) Station and Substations

[C. F. Culler, in charge]

The rescue work in the upper Mississippi River, which is normally taken up in August, was negligible during the summer of 1928. The river remained at an exceptionally high stage, making it unnecessary and impossible to carry on rescue activities and the mussel-infection work, which is dependent upon the above operations. Various trials were made at different points, and only a very few fish were taken. The trout work carried on in connection with the cooperative rearing plan was to a considerable extent successful, although a heavy mortality was experienced in May. The cooperative ponds supervised by this station numbered 76 in Wisconsin and 22 in Minnesota. Rainbow, brook, and Loch Leven trout were the species propagated. A few eggs of the last-named species were collected near Eau Claire, Wis. A personnel was detailed to various field hatcheries, including the collection of lake-trout eggs in cooperation with the Lincoln Park (Chicago) aquarium, propagation of buffalo fish in cooperation with the State of Arkansas, and the usual details to Michigan waters for the propagation of lake trout, whitefish, and pike perch.

Homer (Minn.) substation.—Fish-cultural operations at this point consisted almost wholly of the limited amount of refuge work that was possible under prevailing water conditions. The station served as a base for biological investigations in connection with the upper Mississippi wild-life refuge. Considerable work in the overhauling of boats and trucks, as well as the construction of new boats, was also carried on at Homer. One of the most important items in this respect was the construction of a houseboat, 16 by 50 feet in dimensions, for use in the wild-life refuge.

Lynxville (Wis.) substation.—Activities at this point were also confined to routine upkeep of property and a few scattering collections of fish from the river for distribution.

Marquette (Iowa) substation.—This substation was practically on an inactive basis during the year for the reason cited above.

Bellevue (Iowa) substation.—With the exception of the collection of a limited number of carp and buffalo-fish eggs, which were fertilized and planted in the Mississippi River, no fish-cultural activities were carried on.

MARINE SPECIES

Three stations located in New England are responsible for over 90 per cent of the numerical output of fish and fish eggs. The great fecundity of the marine fish such as cod, haddock, pollock, etc., together with the short incubation period, permits the handling of millions of eggs. The fish hatched from these are necessarily planted in parental waters as fry, and in some instances the eggs are returned directly to the water immediately after fertilization to hatch in the natural way.

Boothbay Harbor (Me.) Station

[Thomas H. Dorr, Superintendent]

The year's fish-cultural work at this station was devoted to the propagation of winter flounder or flatfish and the handling and planting of fertilized cod and haddock eggs on the fishing grounds. During the spawning season of the first-named species, extending from March 5 to April 23, unusually heavy windstorms were prevalent, but as the traps were set in sheltered coves the work of capturing a brood stock proceeded without interruption. From the 8,996 gravid females secured 2,161,051,000 eggs of fine quality were obtained and hatched without unusual loss, and the resulting fry were returned to the natural spawning grounds from which the brood stock was derived.

In the early part of the cod-spawning season, which extended from April 3 to June 13, only one boat was available for making collections of eggs. On the completion of the winter-flounder operations, however, the boat that had been engaged in that work and also the bureau's launch took part in the cod work, and by means of the three boats all fishing grounds from Pemaquid Point to Seguin Island were covered. While the results of the operations fell short of the record collections of last year by about 200,000,000 eggs, the season's total amounted to 1,068,142,000. Between April 22 and May 29 eggs of the haddock were taken along with the cod eggs, the total collections of this species numbering 132,977,000. The usual aquarium exhibit was maintained at the station during the summer months.

GLOUCESTER (MASS.) STATION

[C. G. CORLISS, Superintendent]

Active fish-cultural operations began November 1 with the opening of the pollock-fishing season. Fishing was poor and daily egg collections were much below normal, except for three days near the middle of December, when nearly two-thirds of the season's collection of 596,132,000 were taken. Much better success was attained in the prosecution of the cod work. Eggs of this species were taken from early November to the last week in May, but the bulk of the season's total, amounting to 1,124,802,000, was secured during the three months beginning January 1. Of these eggs 763,163,000 were fertilized and immediately planted on the fishing grounds, the unsuitable water conditions at the time of their collection making it impracticable to incubate them. From eggs developed in the hatchery 274,033,000 fry were hatched and liberated at suitable points along the Massachusetts coast between Rockport and Manchester. Inshore haddock fishing was poor throughout the season, and with only one steamer fishing regularly egg collections were necessarily lighter than under the more favorable conditions of preceding years. Between April 1 and May 25 an aggregate of 104,046,000 was taken, and, owing to unsuitable hatchery-water conditions, all of them were fertilized and planted at the point of collection. Between March 11 and April 8, from a stock of 342 gravid winter flounder secured in the outer harbor, an aggregate of 178,209,000 eggs was taken and incubated, the hatch being slightly in excess of 90 per cent.

Offshore operations.—On February 1 three spawn takers were detailed to accompanying the fishing vessels operating in the offshore fisheries. For a month the take of eggs was light, as most of the fish handled were unripe. Improved conditions prevailed in March but were not sufficiently favcrable to counteract the early lack of success. When the work was discontinued on April 25 a total of 50,009,000 cod eggs and 113,720,000 haddock eggs had been fertilized and planted.

WOODS HOLE (MASS.) STATION

[G. R. HOFFSES, Superintendent]

The fish-cultural work at this station differed from that of previous years inasmuch as no cod were propagated. The old water-supply tanks were replaced and the new tanks could not be completed in time to permit of the conduct of cod-hatchery work. However, two of the station employees were detailed on trawlers on one of the large fishing companies to collect and plant fertilized eggs. In view of the large number of fish caught, the number of eggs taken was somewhat disappointing, but the possibilities seem to warrant further consideration of the project. The usual propagation of winter flounder was carried on, and the attempt to secure a brood stock was undertaken somewhat earlier than usual. The results showed, however, that no benefit accrued from these early attempts. The operation of about 25 fyke nets in Waquoit Bay from January to March gave a total of 3,350 adult fish, of which 2,846 were females. Eggs to the number of 880,000,000 were obtained from them, and a very satisfactory hatch of fry was attained. A number of eyed eggs were planted in suitable waters when the hatchery was overcrowded. The fry developed from those undergoing incubation were returned to the natural spawning grounds and to several new locations in Massachusetts and New York. It is reported that highly favorable results have followed previous planting of flounder fry off Marthas Vineyard and at Provincetown. Statements are made to the effect that flounder fishing has become more productive since the first plants were made. An improvement in the method of handling the adult fish has resulted in a reduced loss percentage.

Investigations at to the possibility of propagating alewives were conducted, but it was found that the capture of sufficient fish with mature eggs was too difficult to warrant the effort. A limited number of mackerel eggs was taken from fish obtained at the trap fisheries in the vicinity of the station. The usual exhibit of marine and fresh-water specimens was maintained during the summer in the aquarium. In addition to the replacement of the water tanks, considerable other work was done pertaining to the upkeep of wharves, boats, and buildings. A septic tank was completed, and considerable piping, not only for the water line but for the gas and air line, was replaced at a cost in excess of $1,200.

ANADROMOUS SPECIES, ATLANTIC COAST

The transfer of the Potomac River shad station to a new location at Fort Humphreys, Va., was marked by a hatch of shad closely approximating the highest records of earlier years. The run was abundant and the fish were unusually large. A good hatch of yellow perch was secured also, but the propagation of these forms at the Edenton (N. C.) station gave an output somewhat below normal. Striped bass were again propagated at Weldon, N. C., in cooperation with the State. Only 1,000,000 Atlantic-salmon eggs were handled at the Craig Brook (Me.) station, but it is purposed to rear a larger number to fingerling size before distribution, which will result in a higher stocking value in spite of the reduced number.

Fort Humphreys (Va.) Substation

[L. G. Harron, Superintendent, and R. W. Owens, Acting Superintendent]

The construction of this station, established for the continuation of the shad and yellow-perch propagation heretofore pursued at Bryans Point, Md., had advanced sufficiently toward completion at the opening of the 1929 fish-cultural season to permit of the conduct of hatchery work. The present location of the station is a much more favorable one than the old site, being farther removed from city pollution and much nearer the field where shad eggs are available. The initial fish-cultural work was the assembling of a brood stock of yellow perch, and approximately 22,000 adult fish of that species were obtained from commercial fishermen. Of the 184,470,000 eggs produced by this stock, 92 per cent were hatched and the fry returned to points in the Potomac River from which the brood fish were taken. Between April 22 and May 19, 76,095,000 shad eggs were collected and incubated, this total having been exceeded only once in the history of the work on the Potomac River. All of the fry resulting from this stock, amounting to 88 per cent of the egg collections, were distributed on the native spawning grounds in the river.

Edenton (N. C.) Station and Substation

[William S. Vincent, Superintendent]

The collection of brood yellow perch was almost a failure, due to the prevention of fishing by stormy weather until many of the fish had spawned. The same adverse conditions prevented a satisfactory collection of herring eggs. The destruction of gear necessitated a halt in fishing, and by the time the equipment was again in readiness for operations the fish had migrated to other waters and spawned. The percentage of hatch resulting from the 37,000,000 eggs secured was somewhat higher than usual. The catch of shad at the only grounds in the region now operated was below normal, amounting to approximately 13,000. The catch averaged about 40 per cent of roe fish, and from them over 7,000,000 eggs were obtained for incubation.

Weldon (N. C.) substation.—The striped-bass station at Weldon was again operated in conjunction with the State department of conservation. Considerable work was required to put the plant in condition for operations. A satisfactory run of fish occurred, and over 13,000,000 eggs were taken, which gave a hatch averaging about 70 per cent. Experiments were made in hatching eggs in city water, and the results were satisfactory, although a somewhat longer time was required for incubating them.

FISHES OF MINOR INTERIOR WATERS

The species included under this head comprise virtually all of the game varieties, which are distributed upon the application of individuals or organizations rather than upon general plants made directly from the hatcheries.

While the technique of hatching the trouts, pondfishes, etc., is so well developed as to permit a high percentage of hatch, two aspects add to the difficulty and expense of this work. The first is the popular demand, undoubtedly justified, that the fish be reared to a larger size, sometimes to a legal length, before distribution; the second is the fact that frequently they must be transported hundreds of miles for planting in depleted waters.

In the case of trout the maximum number of fish available for any given season is determined months previously, when the eggs are laid down in the hatchery, and consequently production can not be increased on short notice to meet sudden demands. The production of pondfish is, to a great extent, influenced by weather conditions, which also affect the collection of eggs from wild trout to a considerable degree. A 100 per cent production at each of the 25 stations supplying this class of fish would undoubtedly enable the bureau to fill all current applications with assignments sufficiently large to meet the reasonable expectations of the applicants.

Records of the individual stations show, in most cases, a gratifying increase in the number of fingerlings produced. After years of development work the establishment at York Pond, N. H., was able to supply a number of high-quality brook-trout eggs for other stations. Results have demonstrated the soundness of devoting an entire hatchery to the production of eggs.

As has been frequently emphasized, the production of warm-water pondfish is directly dependent upon the available pond space. Moderately increased outputs can be obtained by intensive and scientific utilization of existing facilities. The bureau leases water acreages, uses natural ponds and sloughs, and in every way attempts to meet the demands of that large section of the country which is adapted to the pondfishes only and calls insistently for bass to the exclusion of other varieties.

ROCKY MOUNTAIN TROUT STATIONS

The six stations and the substations in this area supply the demands of the general public and in addition must furnish fish for the national parks and forests. In the past, western sportsmen were satisfied with the planting of small fish, but it is now necessary to rear a good proportion of the trout to larger size before distribution, and facilities have been expanded at Springville, Utah, Saratoga, Wyo., Yellowstone Park, Wyo., and Bozeman, Mont., in order to meet this requirement. None of the Western States has more than one Federal hatchery at the present time, and the vast area to be stocked has necessitated the operation of this group of stations at the utmost safe limit of their capacity.

BOZEMAN (MONT.) STATION AND SUBSTATIONS

[W. T. THOMPSON, Superintendent]

The close cooperative relations heretofore existing between this station and the Montana Department of Fish and Game were maintained. During the year the station received from the State 802,000 black-spotted trout eggs, 1,335,000 grayling eggs for development at its Meadow Creek auxiliary, and a consignment of more than a million eggs of that species for its Glacier Park substation. In return the State was furnished over 2,000,000 eggs of the Loch Leven trout. The State also supplied two consignments of adult aquarial specimens, most of them grayling.

The year's output was somewhat smaller in numbers than that of the past two years, but the quality and size of the fish sent out were the highest in the history of the work in this field. The good results were made possible by the fact that there was an entire absence of disease during the spring, and at the close of the fiscal year brook and rainbow trout fingerlings No. 4 were being shipped at the rate of 125 to 150 per can or pail. The total collection of trout eggs for the year amounted to 17,122,200, and 5,639,735 additional were received through the medium of exchange. Over 10,000,000 eggs were shipped on assignment in addition to those transferred between Bozeman and its auxiliaries. The utilization of the remodeled nursery and rearing ponds, together with the increased water supply, has tended toward the production of much larger and better fish than formerly.

No brook-trout eggs are taken in the Bozeman field and all needed eggs are obtained by exchange. During the winter 500,000 eyed eggs of this species were received from Colorado in return for eggs of the rainbow trout. With the view of hastening distribution, 225,435 eggs of this variety, taken early in the season, were obtained from the Neosho station in December and January. These were not more than average in quality, and the loss suffered during the incubation and sac stages was heavy, due partly to the numerous crippled fish eliminated. After feeding commenced, however, conditions improved, and the quality of the fingerling fish distributed was satisfactory. Ninety-six thousand early Montana rainbow eggs were received from a commercial hatchery in that State, in exchange for an equal number of eggs from wild trout of the Madison Valley region, the latter being desired for improving the brood stock. More than half a million eyed rainbow eggs were received at the station from the Madison Valley field in June.

In July, 1928, 210,000 eyed black-spotted trout eggs were received from the Montana commission, and 505,000 were derived from the bureau's station in the Yellowstone Park. In May, 1929, additional early black-spotted trout eggs to the number of 853,200 were received through exchange with the Nevada fisheries authorities. The securing of these early taken rainbow and black-spotted trout eggs has proved a distinct advantage, as it has made possible an early distribution of large fingerling fish and has obviated the necessity of deferring deliveries until late in the season. It is hoped that this practice can be continued on an extensive scale in the near future.

The Loch Leven trout is our pride and also our despair. Probably no other eggs equal in quality those obtained in Odell Creek from wild trout of the Madison Valley, but the fry and fingerlings in troughs, but more especially in ponds, are decidedly bad actors. Green eggs of this species to the number of 4,562,400 were transferred directly from the Odell Creek traps of the Meadow Creek auxiliary, 4,000,000 eyed eggs were shipped on assignment from the Washington office or in exchange, and some 200,000 fingerlings were on hand at the close of the year. Bozeman station was fortunate in securing 50,000 eggs of the golden trout from California. They were divided into two lots, one going to the Glacier Park hatchery and the other was incubated at Bozeman and the product planted as fingerlings in a virgin lake.

Profitable experiments with prepared fish foods were conducted. These foods may be grouped into three lots. The first proved excellent in combination with fresh liver or as a substitute in periods of scarcity. The second group was found to promote the growth of the fish satisfactorily for a period of three or four months. It then appears to break down as a sole food, which, necessitates the use of a supplementary food to maintain the health and growth of the fish. The third appears to be a perfect food when used alone, giving better results than even the best of fresh liver up to four and one-half or five months. What results can be obtained by feeding these two higher groups in combination and also with fresh liver remains to be seen, but it is confidently believed the results will be better than when any one of the three is used alone.

Meadow Creek (Mont.) substation.—For the third successive year this auxiliary secured upward of 14,000,000 eggs from wild Loch Leven trout in the Odell Creek field. Green eggs numbering 2,023,100 were shipped to the Montana State hatchery at Big Timber, and 4,562,400 were transferred to the Bozeman station by truck, being carried in ordinary distribution cans. These eggs were eyed, part of them shipped, and the remainder hatched with a total loss of only 4½ per cent. The rainbow-egg harvest exceeded that of the previous year by more than a half million, amounting to 3,002,300 as against 2,450,000 in 1928. Their quality was excellent. After developing to the eyed stage 561,400 were shipped on assignment and 1,055,500 were transferred to Bozeman and the Glacier Park hatchery. Fry to the number of 1,032,000 were produced from the retained eggs. Green black-spotted trout eggs to the number of 592,000 and 1,335,000 grayling eggs were received from the Montana commission's spawning field at Georgetown Lake. The grayling eggs were of exceptionally fine quality and were very large, running about 600 to the ounce as against the usual 800 or more.

Glacier Park (Mont.) substation.—This field was exceptionally active along formerly established lines, and much new work outlined had progressed well along toward completion by the close of the year. This includes the construction of a series of eight large rearing ponds, the provision of a new and improved water supply and the construction of new troughs for the hatchery. Experimental field operations, which appear to hold considerable promise for the future, also were inaugurated. Some interesting investigations made in March demonstrate beyond question that in at least one lake on the western slope—Logging Lake—the black-spotted trout spawns in February and March under heavy ice in a bottom temperature around 35° to 36°. It is hoped that practical work can be undertaken during the coming year to secure these valuable early eggs.

At the opening of the fiscal year 123,000 eyed eggs of rainbow trout and 318,000 fry of that species were on hand. From these, 435,000 fingerlings were developed and planted by the National Park Service. Additional eyed eggs to the number of 463,000 were received in June, 1929, and at the close of the year were partly hatched. In July, 1928, 994,600 black-spotted trout eggs were received, from which 983,300 fry were hatched and 965,000 fingerlings No. 1 reared and distributed in park waters before the close of fall operations. A lot of 89,500 early black-spotted trout eggs was received by exchange from the Nevada fish and game commission, and 119,200 eggs were secured as a result of experimental field work on Fish Creek. This stock, in the form of fingerlings and eyed eggs, was on hand when the year closed. Twenty-five thousand eggs of the beautiful golden trout of California were received in July, and from them 21,000 fingerling fish were developed and planted, a distant virgin lake well up toward the crest of the Continental Divide being selected for the purpose.

Miles City (Mont.) substation.—A small consignment of largemouth black bass breeders was introduced in this lake in April, 1928. When drawn down during the succeeding October for the removal of carp, which were supposed to have gotten in the lake with the water pumped from the Yellowstone River, 4,810 choice bass fingerlings No. 5 were found. In November, 1928, and January, 1929, two carloads of assorted largemouth black bass, crappie, and sunfish were received and deposited in the lake, and early in March two additional consignments of bass, received through the cooperation of local organizations and residents of the region, were also introduced. The total of these two plants aggregated 935 bass, 677 crappie, and 611 sunfish, all of excellent quality. A cold spell was experienced shortly after the lake had been stocked, and ice to a depth of 30 inches formed on the surface, followed by a covering of heavy wet snow. This resulted in a heavy loss of brood fish through suffocation. A drain has been excavated from below the outlet of the lake to a slough connecting with the Yellowstone River. This will aid materially in draining the lake.

LEADVILLE (COLO.) STATION

[C. H. VAN ATTA, Superintendent]

Somewhat extensive improvements were made to the station buildings and equipment. A commodious combination carpenter and machine shop was completed and the machinery installed. A station garage, 24 by 66 feet in dimensions, with a concrete floor, was constructed, the building being of sufficient size to accommodate all of the station trucks and other vehicles. In the course of the year 30,000 feet of lumber were sawed and planed into sizes suitable for future repair and construction work, making possible a reduction in building costs to a very low minimum. The rest of the station buildings were kept in good repair. A "Caterpillar Ten" tractor and a "Novo Double-Drum" hoist were purchased for use in putting Crystal Lake in condition to be stocked. The tractor will also be used for clearing roads in winter and for many other purposes.

The station's output of fish, distributed by fisheries car No. 8 during the fall, consisted in the shipment of approximately 3,635,000 brook, 175,000 black-spotted, and 173,000 Loch Leven trout fingerlings, as well as 2,700 largemouth black bass, the latter having been collected by the station force from a reservoir that was being drained at Rifle, Colo. During July the station acquired, by shipment from the Yellowstone Park, a consignment of approximately 300,000 black-spotted trout eggs. During the fall the usual egg-collecting fields were operated on the established share basis and yielded 6,221,000 brook and 133,000 Loch Leven trout eggs. Of this total, 1,050,000 eyed eggs were shipped to other stations and 4,723,000 healthy fry were hatched from the remainder—a percentage of 91 of the retained stock. After making deductions to cover the owners' share of these fish, there were on hand at the close of the fiscal year, in round numbers, 3,260,000 brook and 115,250 Loch Leven trout fingerlings, and 65,000 rainbow, 150,000 black-spotted, and 250,000 brook trout from the hatch of the previous year.

Crystal Lake, a privately owned property leased by the bureau, is being developed as a future source of supply for rainbow-trout eggs. This 9-acre lake, situated about 4½ miles from the station reservation, was formerly a brook-trout water. It having been ascertained, however, that it would be of more value to the bureau as a rainbow-trout egg-collecting field, the work with brook trout will be abandoned and all efforts confined to stocking the waters with the rainbow species.

Creede (Colo.) substation.—The site for the new substation at Creede was surveyed during the year, and the water-supply system is in course of development. When completed, which will be some time during the fiscal year 1930, this substation will be equipped for the propagation of brook, rainbow, and black-spotted trout on an extensive scale.

Yellowstone National Park (Wyo.) Substation

[C. F. Culler, in charge]

Field activities at this point cover two fiscal years. At the beginning of July, 1928, the collection of black-spotted trout eggs was proceeding very satisfactorily and the final collection for the season amounted to 23,000,000, of which over 12,000,000 were taken after July 1. Average success in incubating the eggs was experienced, and the usual plan of distribution in park waters was followed. Normal weather conditions permitted the construction of a new hatchery building, and other necessary construction work was carried on, including the completion of 10 new rearing ponds at Mammoth Hot Springs during the spring. The egg-collecting season that was opening at the close of the fiscal year failed to show as satisfactory results as those of the previous year. Up to the end of June 6,500,000 eggs had been taken.

Saratoga (Wyo.) Station

[S. M. Ainsworth, Superintendent]

Under authority of a special appropriation, considerable work was done on the construction of a new cottage for housing station employees; the station garage was enlarged to nearly double its former capacity, and a new 12-inch wood-stave pipe line was laid to connect the spring-water supply with the distributing reservoir. The station buildings were repainted, and the appearance of the reservation was further improved by the grading of grounds and driveways, cleaning up sagebrush, etc.

The season's collection of brook-trout eggs was the largest in the history of the station, 1,930,000 being secured in the Big Creek Lakes field and 227,000 from the domesticated brood stock. All eggs taken were a little above the average in quality. Eyed eggs to the number of 420,000 were transferred to other stations, and, owing to insufficient holding capacity at the station, 460,000 fry were turned over to the Wyoming State hatchery for rearing. A satisfactory egg supply was produced from the Loch Leven brood stock, though the average yield per fish was not large, many of the breeders being very young. A shortage of nearly a million rainbow eggs, as compared with last year's returns in the Lost Creek field, is ascribed partially to the very late spring in that region. An excessive rise in water temperature, occurring in the latter half of the spawning period, also caused heavier-than-normal losses. Part of the eggs taken were shipped in the eyed stage, and approximately 708,000 fry were hatched and returned to their native waters. A lot of 100,000 black-spotted trout eggs forwarded to the station from the Yellowstone Park field yielded more than 77,000 fingerlings Nos. 1 and 2 for distribution in Wyoming waters. From a consignment of 305,000 eyed eggs of this species, furnished by the Nevada State Fish Commission in return for an equal number of rainbow eggs, 271,000 fry were hatched, of which 262,000 in the fingerling No. 1 stage were on hand at the close of the fiscal year, together with over a million fry and fingerlings of other species.

SPEARFISH (S. DAK.) STATION AND SUBSTATION

[D. C. BOOTH, Superintendent]

The young game trout on hand at the beginning of the fiscal year were given wide distribution as large fingerlings during the fall months. The main entrance drive, with a massive concrete wall on each side, on which are electrically lighted columns, was completed during the year. While there has been an ample supply of pure mountain spring water for incubating the eggs and carrying the young fingerling trout in the troughs, the station has long been handicapped by an inadequate volume for holding over any considerable number in nursery ponds for distribution after attaining a length of 4 or 5 inches. This condition was changed last fall by the construction of a concrete dam, providing sufficient head, and laying some 700 feet of 8-inch wood-stave water pipe. An adequate volume of water is now available for every pond, 14 in number, on the lower grounds. In addition to caring for several thousand adult and yearling fish, approximately 250,000 fingerling brook, rainbow, and Loch Leven trout 2 inches in length are now being held in nursery ponds supplied with this water, with the intention of distributing them when they have attained a length of 4 or 5 inches. The brood-stock ponds were deepened and enlarged, a long concrete wall was constructed along the storm channel, a portion of the hatchery-building roof was reshingled, and the whole station is in good condition.

Fish-cultural operations were conducted along the same general lines as in previous years, eggs being taken from the station brood stock and their numbers supplemented by collections from wild trout and by purchase and exchange. Two million brook, rainbow, and Loch Leven trout eggs were handled during the year, over 900,000 fish were distributed, and upward of 600,000 were on hand at the close of the year awaiting shipment later as large-sized fingerlings. Several kinds of food were used, but none was found as satisfactory as beef liver and beef heart for the small fish and sheep liver for the adults. The station personnel was able to render considerable assistance to various clubs and individuals interested in restocking public waters, including several commercial fish culturists. The station also cooperated with officials in solving stream-pollution problems.

Crawford (Nebr.) substation.—This substation has been under construction during the entire year. A building 24 by 52 by 12 feet was erected for use as a garage, shop, fish-food room, and for storage. A 1-story frame cottage for the use of the foreman was completed, and at the close of the year the frame hatchery building, 35½ by 65 feet in dimensions, was about 85 per cent completed. Three nursery ponds were constructed at the pumping plant on the Fort Robinson Military Reservation and put in service. They seem to be well adapted to trout rearing. The ice pond was converted into a breeding pond for rainbow trout by putting an 8-inch pipe through the dam. A sunfish pond was constructed and stocked. The city installed a 6-inch iron pipe connecting the city mains with the hatchery, and a fire hydrant was installed near the hatchery with plugs to fit the Crawford fire department hose.

SPRINGVILLE (UTAH) STATION

[CLAUDIUS WALLICH, Superintendent]

During the year the station brood-pond system was improved by the construction of walls and bottoms of concrete. This change proved very advantageous in the handling and stripping of the rainbow-trout brood stock. Between early December and the middle of March nearly 2,500,000 eggs were taken from this stock, and at the close of the fiscal year the No. 2½ fingerling rainbows on hand as a result of this spawning amounted to 620,000, a pronounced increase over work of the same character last year. To offset this increase the station collections at the cooperative field station at Fish Lake, Utah, fell off, due in a measure to a smaller total collection, with a consequent reduction in the bureau's share. A total of 5,500,000 brook-trout eggs was collected in this field, of which the station received 780,000, shipped 246,400 to the Nevada fish and game commission, and hatched 450,000 to fill local requirements, 80 per cent in the fingerling No. 3 stage being returned to parent waters. The remaining 20 per cent was turned over to the State of Utah for stocking some lakes that are not accessible until July.

The rainbow-trout work in the Fish Lake field was hampered by a late spring and a low water level. Great difficulty was encountered in getting to the lake, huge snowdrifts from 6 to 20 feet deep and a quarter of a mile long in places necessitating an immense amount of shoveling to open the roadway. The take of eggs amounted to slightly under 5,000,000 and the station received 682,000 as its share. Of these, 50,000 were shipped in the eyed stage to Missouri and the remainder were hatched. A high percentage of fry was obtained from the brook trout and the station stock of rainbow trout. In the case of the wild rainbow trout, however, many of the females produced eggs of a glassy appearance with a clearly visible opaque spot inside. Much cooperative assistance was received from the Utah Department of Fisheries in the course of the year. The loan of the State tank trucks in connection with the distribution of fingerling trout was of special aid, enabling the station to accomplish the work much more economically and efficiently than has heretofore been possible. The new concrete-tank system is virtually completed. Ninety-six single or 48 twin tanks, 15½ feet long, 30 inches wide, 30 inches deep at foot, and 25 inches deep at head of tank, have been cast. The tanks will be supplied with water from a concrete flume.

NEW ENGLAND TROUT AND SALMON STATIONS

In no region is the efficiency of artificial propagation of game fishes better attested than in the New England States. While no Federal hatcheries are maintained in Connecticut and Rhode Island, the distribution problem is simplified by comparatively short hauls, and the planting of large fingerlings has been followed to the point where much good fishing is available in spite of the populous conditions in this area.

Hartsville (Mass.) Station

[E. P. Thompson, Acting Superintendent]

During the year four artesian wells were driven and put in service, increasing the station water supply by approximately 150 gallons per minute. The dam of pond E was repaired, and a new sluiceway and outlet box were installed. A cement foundation was placed under the woodshed at the clubhouse, hardwood floors were laid in the fish-culturist's residence, and other needed repairs connected with the upkeep of buildings, equipment, and grounds were made. The station stock of brook trout yielded 350,000 eggs, from which 290,000 fry were hatched and reared to fingerlings. The fingerling fish resulting from a lot of 26,026 rainbow-trout eggs received from the Manchester (Iowa) station were on hand at the end of the year, together with 102,000 brook-trout fingerlings, the remainder of the stock having been distributed previously. The station distribution included an output of 7,064 catfish fingerlings. In the course of the year the station cooperated with nine individuals and clubs, furnishing brook trout for 13 rearing ponds.

Craig Brook (Me.) Station and Substations

[George N. Montgomery, Superintendent]

Extensive improvements were made during the year. Two ponds were combined with a larger one, and five old ponds out of commission were repaired and put in condition to hold fish. Pond No. 35, which for several years has not been used, was cleaned, its banks raised, and a concrete spillway constructed, making available a pond 2,300 square feet in area. Considerable grading of pond banks and roadways was done. A change was made in the piping system so as to permit the flow of waste water from the upper hatchery directly into the lake. A large concrete tank, 98 feet long by 6 feet wide, was constructed below the hatchery building for use during spawning operations, being divided into compartments by wooden racks. The lower hatchery building was painted, and an abandoned boathouse at the Green Lake substation was torn down and the material utilized for constructing a storehouse. Work was begun on the erection of a foreman's cottage. Most of the troughs in the lower hatchery building were replaced by new ones of improved design, which permits their being moved.

The collection of brook-trout eggs from the station brood stock was the highest on record for this field, reaching a total of 2,704,450. Of these, 900,000 in the eyed stage were transferred to other stations. A number of exchanges were made whereby brook-trout eggs were secured from commercial hatcheries and other sources. There were on hand at the close of the year almost 250,000 fingerling brook trout to be distributed during the fall.

At the opening of the year the station was carrying 120,000 landlocked-salmon fingerlings, which were distributed later. During November 182,000 landlocked-salmon eggs were transfered to the station from the Green Lake field, and, after developing to the eyed stage, 122,500 were shipped to other points. From the Grand Lake Stream substation 300,000 eggs of this species were received, and 85,000 of them in the eyed stage were forwarded to other hatcheries and to applicants. Some of the fry resulting from the remainder were distributed before the close of the year and some were retained for fall planting. The fry resulting from the usual assignment of landlocked-salmon eggs from the State hatchery at Caribou, Me., were all distributed before the end of June.

In July, 1928, the station was carrying 50,000 Atlantic-salmon fingerlings, all of which were shipped in September. In the following spring 1,000,000 Atlantic-salmon eggs were received from Canada. A number of these were transferred to State hatcheries in Maine. The fingerlings resulting from those incubated at Craig Brook station were distributed in the various salmon rivers, with the exception of a lot of 108,000, which were held for fall planting.

Grand Lake Stream (*Me.*) *substation.*—The number of rearing ponds for the landlocked-salmon and brook-trout work at this point was increased to seven by the addition of the new one constructed during the early fall of 1928, the series being capable of holding approximately 500,000 fingerlings of these species. The salmon fingerlings on hand at the opening of the year were fed through the summer and distributed during the fall with merely nominal losses. The collection of landlocked-salmon eggs extended from early October to late November. Water conditions throughout the season were favorable, and 975,500 eggs of superior quality were secured. The brood fish taken included many first spawners of both sexes. Only two barren females were found, though many were immature, and these were liberated as soon as caught. The loss of eggs in the hatchery was considered normal. On reaching the eyed stage 300,000 were shipped to the Craig Brook (Me.) station. Of the young fish hatched from the remainder, 47,000 in the No. 1 fingerling stage were delivered to applicants, and at the close of the year nearly half a million were being held in six of the rearing ponds and fed. The large number of young salmon now present in Grand Lake is an indication of the excellent results accruing from the liberal planting of large fingerlings therein.

The year opened with 117,445 brook-trout fingerlings on hand from the stock of the previous year. The fish fed freely, grew rapidly, and the loss that usually occurs when the water temperature reaches 70° or over was averted by making an early distribution in the No. 3 fingerling stage. Approximately 200,000 eyed brook-trout eggs received from the main hatchery at Craig Brook were hatched with merely nominal losses. About half of the young fish produced from them were distributed as fingerlings No. 1, and the remainder were being carried at the close of the year awaiting distribution in the fall.

ST. JOHNSBURY (VT.) STATION AND SUBSTATION

[A. H. DINSMORE, Superintendent]

Damage to the dam in Sleepers River by the disastrous flood in November, 1927, was repaired and a new concrete hatchery intake constructed. The usual number of brook-trout eggs transferred from York Pond (N. H.) substation and purchased from a commercial dealer was incubated, and the fry were distributed to applicants and planted in local public waters. In addition to the above, 400,000 eggs of this species, the property of the Caledonia County Forest and Stream Club, were hatched and turned over to the members of the club as fry for stocking public waters in the county. Small numbers of landlocked salmon and steelhead salmon eggs were hatched. All fry of the former species, excepting 3,000, which were transferred to York Pond to test their action in the flowing well water being developed there, were delivered to applicants and distributed in public waters as fry. At the close of the year the young steelheads were being held and reared for distribution as fingerlings.

York Pond (*N. H.*) *substation.*—Improvements to the mess house were continued. A stock room was finished in the basement, the entire roof of the old camp was removed, a story added, and a new roof of composition shingles put on. Ground for canal extension and for much needed pond space was cleared, and at the close of the year new ponds and races were being constructed. The flowing well area is being developed to afford a copious supply of water of uniform temperature. About 15,000 yearling brook trout selected from fish reared from the fry of the previous year have been added to the station brood stock. These and the large stock of adult trout were held with slight losses. Brook-trout egg collections amounted to nearly 3,000,000, being almost twice the collections of the previous year. Of these eggs, 727,307 were transferred to the St. Johnsbury hatchery, other stations of the bureau, and to applicants. The remainder were incubated at York Pond. The usual large plants of fry were made in local waters, and at the close of the year there remained 235,810 of these fish, running at that time up to 2½ inches in length. Fish from eggs forced along in the well water began to feed early in March and were handled with far better results than any attained previously. As usual, the natural fingerlings, resulting from eggs deposited by small females not handled and by the larger fish after stripping were picked up during the late summer from the spawning races. Approximately 3,000 were obtained. Up to midsummer these fish make a far better growth than the artificially fed fry, but beyond that time they make practically no growth unless fed.

Pittsford (Vt.) Station

[Dr. H. S. Davis, Director; R. F. Lord, in charge]

The Pittsford station is being operated as an experimental trout station, special attention being paid to brook trout. Small numbers of rainbow, steelhead, and black-spotted trout are also kept for experimental purposes. During the past year the experimental work has been largely devoted to an investigation of various dry food products that offer possibilities as subsitutes for meat in the diet of fingerling and older trout. It has been found that there are a number of such products that can be fed successfully in combination with fresh meat at a very considerable saving in the cost of food. It is not believed, however, that any of these dry products can be fed alone for any considerable length of time without detriment to the fish.

In addition to the feeding experiments an extensive series of experiments in selective breeding has been inaugurated. This work consists largely in mating individual fish and rearing the young of those pairs that show the greatest promise for further breeding work. While definite results will not be forthcoming for several years, it is hoped that by this means it will be possible to develop strains of trout that will excel in hardiness and rapidity of growth.

Nashua (N. H.) Station

[J. D. DeRocher, Superintendent]

In addition to the routine minor work of maintaining the buildings and grounds in good condition, two new bass ponds were completed and stocked with smallmouth black bass. The station brood stock of brook trout yielded nearly 200,000 eggs, and almost 100,000 were obtained from the station brood stock of rainbow trout. The usual attempts were made to collect eggs from wild rainbow trout at Lebanon, N. H., but a scarcity of mature males made it impossible to fertilize the 69,000 eggs obtained. Shipments of brook-trout eggs from commercial hatcheries and other sources gave the station a total of approximately 1,000,000 of that species. A successful hatch permitted the distribution of a normal output of fry, and at the close of the year a considerable number of fingerlings was being retained and reared for distribution in the fall. A small consignment of landlocked-salmon eggs was received from the Craig Brook (Me.) station. Nashua station has been actively engaged in developing cooperative nurseries in the State, and a number of brook trout were allotted to the five establishments in operation during the year.

COMBINATION TROUT AND POND STATIONS

A water supply adapted to the propagation of trout may be utilized in propagating pondfishes, although the reverse may not be true. Consequently, while the surrounding waters are suited to bass and there is sufficient area available, some of the stations in the Middle West and Middle Atlantic region operate a considerable acreage of ponds for bass, sunfish, and crappie. The output of pondfish from these stations has generally not been large but is sufficient to provide for local distribution and relieve the pressure upon the regular pond stations.

ERWIN (TENN.) STATION

[A. G. KEESECKER, Superintendent]

During the year the station plant was improved by the construction of a concrete retaining wall approximately 150 feet long and 8 feet high, creating a catch basin for flood waters caused by drainage from the new Federal highway through the station grounds. Thus far this wall has prevented overflow of the trout ponds, but some other arrangement will have to be made for the protection of the bass ponds, as the wash from the road is filling them gradually with mud and sediment. About 200 cubic yards of mud were taken out of the ponds in the course of the year, materially increasing their rearing capacity. A new driveway was constructed from the hatchery to the superintendent's residence, and concrete walks were built from the main hatchery to the fish-culturist's residence and to the spring. The pond system was improved by raising the walls of several ponds and afterwards refilling them with earth and resodding them. Improvement of sanitary conditions by eliminating the disposal of sewage into the waste branch required the building of three concrete sanitary tanks with the necessary drains.

Between November 1 and February 28, 868,880 rainbow-trout eggs were taken from the station brood stock. Two lots of brown-trout eggs, aggregating approximately 153,000, were incubated for private parties. All brook-trout eggs handled were received by transfer from the St. Johnsbury (Vt.) station, and the average number of fingerling brook trout was produced and distributed. The output of rainbow trout was about the same as last year. The very cold and rainy spring retarded the spawning of the pondfishes, and the roily water hindered the collection of the fry to a great extent. However, approximately 34,000 fry and fingerling largemouth black bass were distributed, and it was estimated that about 20,000 remained in the brood ponds. A normal season's output of rock bass and sunfish is expected.

MANCHESTER (IOWA) STATION

[G. H. GILL, Superintendent]

The output of rainbow trout from this station was larger than for the past 10 or 12 years. One-third of the 2½-year-old brood stock produced eggs of high quality at the rate of 650 per female, and between December 12 and April 24 a total of 1,200,000 eggs of this species was collected. Brook-trout eggs to the number of 602,000 were received, 500,000 being shipped from the State of Idaho and the remainder from a commercial hatchery. All arrived in good condition, and there was entire freedom from diseased conditions throughout the year. Some trouble was experienced with rats, however, and before they could be exterminated many brook-trout fingerlings had been destroyed. The rodents consumed the body but discarded the head of the fish. At the close of the year there were on hand 90,000 rainbow and 100,000 brook trout fingerlings. A few adult smallmouth black bass constituted the station's entire brood stock of warm-water fishes during the spawning season. From these nearly 3,500 2½-inch fingerlings were produced, and the brood stock was augmented by the addition of 35 breeders matured during the year in the station ponds. Experience has shown that these fish develop rapidly by using young goldfish as forage for them. Painting and repairing the hatchery and two other buildings and the construction of 500 feet of cement side wall, drains, and cross dams in two large canal ponds constituted the most important work in the maintenance of the station. A new Reo 1-ton truck was received by transfer from the La Crosse (Wis.) station.

NEOSHO (MO.) STATION AND SUBSTATIONS

[W. H. THOMAS, Superintendent]

The special appropriation available since December, 1927, has been utilized in making extensive repairs to the trout and bass ponds, the creek retaining wall, and the water-supply system; all buildings have been placed in good repair and painted; most of the sediment clogging the McMahon Spring water-supply line has been removed by the insertion of two 6-inch blow-off valves at proper intervals. New fencing has been built around the station grounds, piping for natural gas has been run to all of the buildings, and needed alterations to the annex have been effected. A mechanical refrigerator recently installed for the preservation of fish food has proved effective and economical, the food being held in better condition than formerly and at a cost not exceeding one-fifth of the former outlay for ice.

The propagation of rainbow trout was conducted by segregating the adult fish according to age. By this means the egg-taking process involves less work than by the former method of mixing the eggs from fish of different ages. At this station all rainbow trout are distributed or planted after attaining the age of 3 years. The parasite Gyrodactylus infected all the rainbow-trout fingerlings during the early part of their existence, but it was easily controlled by treatment. Horse meat was used for feeding a portion of the adult and fingerling rainbow trout at Neosho until near the close of the year, when it was discontinued because of the expense and the fact that such food makes the ponds unsightly. The parasite *Proteocephalus ambloplitis* is prevalent among the pond fishes at this station, and to break up the life cycle of the parasite it is essential to "winter" the ponds. However, this operation causes excessive seepage from the ponds and a resulting depletion in the microscopic life so necessary as food for the young fish. In order to at least partially overcome these conditions fertilizer was used extensively and Daphnia planted at intervals in all of the ponds. Approximately 32,000 fingerling bass were collected and distributed prior to June 30, and the indications are that the fall collections will be somewhat in excess of those of the previous year. Rock bass, crappie, and catfish also were propagated, and the prospect of securing a large collection of crappie for fall distributions is very good.

Bourbon (*Mo.*) *substation.*—Although the season's egg collections of rainbow trout were the largest ever made since the bureau began its cooperative work at this point, their quality was somewhat inferior to that of last season. The fingerling rainbows developed normally untill the beginning of May, when an organic disease made its appearance, and the various remedies applied proved ineffective. For the past 18 months horse meat has been used for feeding the rainbow-trout adults and fingerlings above the No. 2 stage. The trout at this point are held in a raceway, which does not become unsightly from the use of the food owing to the large volume of water that passes through the race. The hatchery grounds were inundated by heavy rains, but this resulted in no loss of fish because of the security afforded by the fine-mesh wire fence recently installed for the protection of the raceway and ponds.

Langdon (*Kans.*) *substation.*—Receipts of warm-water fish from ponds in this section have exceeded all previous records. There were collected and distributed approximately 203,000 fish, consisting of largemouth black bass, crappie, rock bass, sunfish, catfish, and yellow perch. More than half of the fall distribution was of black bass.

White Sulphur Springs (W. Va.) Station

[Edward M. Haynes, Superintendent]

A new electric light and power line was installed throughout the station during the year at a cost of $515, and an electric refrigerator was purchased and installed. Partial painting of the interior and exterior of the station buildings was accomplished. The activities in respect to the number of trout eggs handled did not equal those in 1928 by more than 500,000, the shortage being due to the smaller number of brook-trout eggs obtained from commercial fish-culturists. The grand total of output for the past year amounted to 3,882,810, in addition to the stock furnished to the State of West Virginia. In all, 3,464,000 trout eggs were collected from the station brood fish. The Cheat Club cooperative nursery at Durbin, W. Va., was conducted as heretofore under the supervision of the station. The agreement hitherto governing cooperative work with the West Virginia Game and Fish Commission was again effective. In pursuance of this plan the station incubated 1,200,000 brook-trout eggs for the State, receiving 350,000 of the eyed eggs in payment for this service. All brook-trout eggs handled at the station were derived from exchanges or from purchases made by the State. The station Loch Leven brood stock yielded 354,000 eggs of excellent quality, and approximately 140,000 additional were received from the Bozeman (Mont.) station. Rainbow eggs of superior quality were collected from the 3, 4, and 5 year old fish held in the station ponds. In addition to numerous shipments of eyed rainbow eggs sent to various parts of the United States, one consignment was sent to Cuba and one to South America.

WYTHEVILLE (VA.) STATION

[C. B. GRATER, Superintendent]

One of the minor improvements begun at this station was the widening of the road connecting the station grounds with the county highway. The production of rainbow-trout eggs from the station brood stock was limited to 400,000, as the 3-year-old fish, from which a large number of eggs had been expected, failed to reproduce in significant numbers. An epidemic of Octomitiasis caused heavy losses among the fingerlings. The cooperative nursery work in conjunction with the State of Virginia has been extended so that now four large nurseries, capable of handling over 500,000 fish, are in operation. These were stocked with brook and rainbow trout fry from the Wytheville station, but the infection previously mentioned caused heavy losses after the fish were transferred. All brook-trout eggs handled were secured by transfer from other points, and this species also suffered heavy mortality in the fingerling stage. The production of pondfish was about normal, with 9,000 fingerling largemouth bass distributed in October and 6,000 fry during the spring. Twenty-one thousand smallmouth bass fry were also produced for the spring distribution, together with a small production of rock bass.

PONDFISH STATIONS

Seven stations comprise this group. Several of them are required to spread their output over two States, with consequent difficulty in meeting all demands. An important function of this group is the stocking of numerous small private artificial lakes and ponds in the Southern States.

COLD SPRING (GA.) STATION

[CHARLES A. BULLOCK, Superintendent]

Five of the station ponds were enlarged, giving them an area from 5 to 50 per cent greater than formerly. All remaining wooden overflow boxes in the larger ponds were replaced with new ones of concrete; the channel of Cold Spring brook was straightened and confined with concrete retaining walls, and various repairs were made to buildings, including the shingling of one of the residences and reweatherboarding the open side of the barn. The old wagon shed and stables were razed. A new highway through the station grounds from the main entrance to the rear entrance was completed by building up and widening the banks of two ponds bordering the main station brook and by building a concrete bridge across Cold Spring brook at its junction with the main brook. Notwithstanding the frequent roiling of the pond-water supply from the wash occasioned by the building of a State highway across the reservation, and an apparent shortage of fish food through the comparatively small production of daphnids in the ponds, the station was able to establish a record in its yearly output of bass, the 404,000 distributed exceeding slightly the number in any previous year since the station was established. The two ponds devoted to the propagation of bream yielded an output of 50,000, and about 6,000 catfish were raised in a pond set aside for the breeding of that variety.

Work at Harris Ponds was conducted along the same lines as in the previous year. Only a limited number of adult bream was available for brood stock, and after placing them in the ponds no food or other attention was given. When the ponds were drawn in September about 37,000 young bream were secured and added to those awaiting distribution in the ponds at Cold Spring station.

The work of developing the newly acquired hatchery site near Valdosta, Ga., was begun in the summer of 1928 and continued throughout the year. About 200 acres of this site can be converted into fish ponds. The property has been fenced, a foreman's cottage, garage, and workshop constructed, and two boats built. One natural pond, over 40 acres in area, was drained with about 250 yards of large-diameter tile, and a holding platform, pools, and water-supply line were installed. Underbrush and trees have been cleared from the timbered section between and around the margins of the two natural ponds. One well was driven and a second is being constructed to serve as outlets for the larger natural pond.

EDENTON (N. C.) STATION

[W. S. VINCENT, Superintendent]

During the year an effort was made to increase the production of pondfish by fertilizing the ponds and introducing fish food. A driveway of the tarvia and rock type was constructed from the station grounds to the new State highway. A garage and storehouse were constructed, and minor improvements and repairs were made to other buildings. The dilapidated boathouses were torn down and the lumber stored for future use. The former submarine telephone line was abandoned, and connection was made with the line following the new highway. The production of sunfish was very satisfactory, an output of over 40,000 closely approximating previous records at this station. In spite of a large brood stock of crappie, the production of this species was practically negligible. Following a limited distribution of bass fingerlings in the fall there was every prospect of a first-class hatch during the spring months. Bad weather developed, however, making it impossible to collect the schools, and the fry distribution was limited. It is expected, however, that the large number of fingerlings remaining in the pond will insure a comparatively large distribution during the fall months. Considerable distribution was carried on by truck and it was found that this method of handling fish results in a material saving.

LOUISVILLE (KY.) STATION

[CHARLES W. BURNHAM, Superintendent]

Only the more necessary construction, painting, and repair work was given attention, and all of it, with the exception of installing new rain gutters on the fish-culturist's house and repainting the water tank and tower, was performed by the station employees. The ceilings and walls of the living room, kitchen, and bathroom in the superintendent's residence were repainted. The floors in the living room, dining room, halls, and stairs of this building were revarnished. New tar-paper roofing was put on the stable. Six wire-screen covers for fish troughs were made and painted. The stable and storehouse were each given two coats of paint, and all fish-cultural equipment was repaired and repainted as usual. This year the city of Louisville built a new concrete road, 20 feet wide, on the Western Parkway between the State fair grounds and the station reservation.

Operations connected with the propagation and distribution of smallmouth black-bass fry and fingerlings constituted the principal fish-cultural work of the year. The output of this species amounted to 531,000 fry and 11,060 fingerlings, slightly exceeding the station's record for any preceding year. The successful production of more than 500,000 smallmouth-bass fry annually over a period of years indicates that climatic and other conditions at Louisville station are favorable for such work. The loss of eggs or fry because of unfavorable weather is a rare occurrence, and the station is not subject to the floods that have caused such serious losses of eggs and fry elsewhere. The station also handled small numbers of largemouth black bass, rock bass, and bream fingerlings. As the station is not equipped with rearing ponds, the production of fingerling fish is confined to such as may be taken from the breeding ponds. Owing to the dense growth of aquatic vegetation, it was necessary to remove large quantities from every pond.

MAMMOTH SPRING (ARK.) STATION

[DELL BROWN, Superintendent]

The usual work of keeping the station grounds in good condition was performed by the station force. The old warehouse was moved to a new site, placed on a concrete foundation, and fitted up as a warehouse, workshop, and garage. The old barn was rebuilt on a concrete foundation. The completion of this work places all buildings on the station reservation in excellent repair. Though a large stock of smallmouth black bass breeders was available for spring spawning nesting was greatly interfered with by unfavorable weather. There were only 56 nests of eggs, but of these 43 were productive, and the season's output of this species amounted to 116,000 fingerlings. The schools of young bass from the nesting of the largemouth species were unusually large, and 144,800 fingerlings were produced. There was also a satisfactory output of rock bass and sunfish. For the greater part of the year the superintendent was engaged in cooperative fish-cultural work and in supervising the construction of the new State hatchery at Lonoke, Ark. Six thousand No. 5 largemouth bass were shipped from the Mountain Home (Ark.) cooperative pond, and the output from the Lonoke cooperative station amounted to 411,000 of the same species. It is expected to have a much larger pond area available for the work at Lonoke in advance of next season's work.

ORANGEBURG (S. C.) STATION

[G. W. N. BROWN and S. A. SCOTT, Superintendent]

A drainage canal approximately one-fourth mile long, 4 to 10 feet wide, and about 8 feet deep, was excavated on the south side of the two reservoirs to take care of excess surface water collecting above the station grounds. At the lower end of this canal two retaining walls, 8 inches thick, 8 feet high, and 200 feet long, were constructed to prevent the current from undermining the reservoir banks and to form a division between reservoir No. 2 and the canal. Approximately 400 feet of drain pipe from five ponds had to be dug up and replaced for the most part with new pipe, the old line being broken apart or clogged with sand, making it almost impossible to draw down the ponds. The interior of the first story of the superintendent's residence was painted, the floors milled and varnished, and new electric-light fixtures installed. The heating system was repaired and placed in working condition. New lawn fence was placed between the station grounds and the superintendent's residence. Two large gate posts were built at the vehicular entrance to the station property. On September 18 and 19 a severe wind and rain storm damaged the station considerably, uprooting 130 trees, some of which fell across the buildings. More than 7 inches of rain fell within 48 hours, flooding practically all the ponds and washing out the roads.

As a whole, the fish-cultural work was successful. The collection of largemouth black bass was one of the largest in the history of the station, the output amounting to 376,780, of which number 129,300 were advanced fry and the remainder fingerlings. Other species handled were bluegill bream, crappie, spotted catfish, and warmouth bass. Crappie and catfish are only a partial success at this station. For the first time at this station the distribution of fish by truck was undertaken on a large scale and proved a very economical and successful method for distributions within a radius of 150 miles. A new 1½-ton truck was equipped to carry 42 cans as a maximum load. The spring distribution by truck cost approximately 2 cents per mile, as against 6 cents per mile where distributed by train. The station trucks traveled over 3,000 miles in connection with the spring distribution.

SAN MARCOS (TEX.) STATION AND SUBSTATIONS

[O. N. BALDWIN, Superintendent]

Work at this station included the painting of three dwellings. Additions were built on the workshop and the garage, and an abandoned pumphouse was dismantled. The station property was wired for electric lighting, and seven large street lights were erected in the grounds. The work of pond improvements was continued by the excavation of pond No. 6 and the erection of 225 feet of concrete wall to prevent seepage. Several other ponds were given attention in the way of deepening and expanding their area. A rack was constructed across the slough in the San Marcos River, cutting off an area of approximately 5 acres for use in the propagation of bass. Considerable effort was necessary to remove an enormous growth of aquatic vegetation, logs, stumps, and other débris. The ponds were stocked with 100 brood bass, but the flood near the close of the fiscal year washed out part of the rack, and all of the adult and young fish retained therein were lost. The appearance of the station grounds was improved materially by the removal of old fencing, grading of grounds, etc. The brood stock of bass was increased by a number of fish secured from a private club lake. There was every indication that the output of fry and fingerlings would have been equal to or greater than that of the previous year if the above-mentioned flood had not mixed the fish and halted the distribution, causing considerable loss. However, 153 applications were filled, utilizing approximately 150,000 fish. The much larger number of fingerlings now being distributed from this station has the effect of reducing the numerical output though it increases the stocking value. Bream were also propagated, and the usual plan of propagating crappie by stocking private ponds on neighboring ranches was followed. Fish obtained from this source were sufficient in number to supply approximately 150 applicants. A few rock bass, warmouth bass, green sunfish, and Rio Grande perch also were propagated.

Fort Worth (Tex.) substation.—While this substation was not entirely completed, the installation of temporary standpipes in the ponds permitted the introduction of a brood stock, and a reasonable output of fish is expected during the coming year. The work accomplished to date consists in the construction of five ponds with main-pipe connections and the erection of a dwelling.

New Braunfels (Tex.) substation.—This substation was operated with average success, furnishing approximately 15,000 bass and a considerable number of bream, which were transferred to the San Marcos station.

Medina Lake (Tex.) substation.—The ponds at this point produced approximately 25,000 bass and a few bream. Twenty thousand rainbow trout were received from the Neosho (Mo.) station for rearing and planting in near-by waters.

TUPELO (MISS.) STATION

[CHARLES R. WIANT, Superintendent]

Very satisfactory work in fish culture was accomplished at this station. As regards numbers, the production of black bass was not as large as in 1928, but the fish distributed were of greater value than last year, as approximately 38.37 per cent were large fingerlings that had been held and fed throughout the summer and early fall. During the past two years the proportion of fingerling bass produced was not greater than 22 per cent of the entire output. Of the 43,055 fingerling bass collected when the ponds were drained, 7,530 were taken from one 3-acre pond that had been stocked with 23,000 fry during the preceding May. Most of the bream distributed were also sent out in the late fall and consisted mainly of large fingerlings. After completing all shipments in the Tupelo field a surplus load of bass and bream was taken on board by fisheries car No. 8 to be supplied to applicants in Indiana and Illinois. The total output of these species exceeded 721,000. The distributions also included 1,875 catfish.

One of the more important improvements during the year was the erection, near the new pumping plant, of a 10,000-gallon steel tank on a 25-foot steel tower and the laying of new piping to connect it with all buildings on the reservation. A 1½-story building, 18 by 30 feet in dimensions, was constructed on the site of the old workshop for general utility use. This structure has been fitted up to house a carpenter shop, meat room, coal room, and tool room, with storage space overhead. A double garage to accommodate the two station trucks was built from lumber salvaged from the old workshop.

Aliceville (Ala.) substation.—This plant consists of four ponds having a combined area of 6.53 acres, two of which were used for the rearing of bass and two for the production of bream. Only fingerlings were distributed, and the output of the two species for the year amounted to approximately 33,500. Practically all of these were called for at the station, and delivery was made at the expense of the applicants. To augment the water supply, which is from two flowing wells, a well was excavated and a pump and engine installed. At the site of one of these wells a shipping shed, sheltering three large holding tanks, was erected. A garage was also constructed.

LAKELAND (MD.) PONDS

[E. K. BURNHAM, acting in charge]

Distribution of fish from these leased ponds, located just outside of the city of Washington, is carried on in the fall. The output for the season was disappointing, comprising approximately 40,000 sunfish, 8,400 crappie, and 13,500 bass. Apparently the hatch of the preceding spring was below normal in spite of favorable weather. The ponds were wintered dry and stocked with the requisite number of brood fish during the spring of 1929. The ensuing hatch of bass was excellent, over 100,000 fry being accounted for by transfer among the various rearing ponds. A normal hatch of sunfish and crappie was observed, and at the close of the year there was no indication of any marked decline in fingerlings. A brood stock of bass is now being reared at these ponds, which will obviate the necessity of making replacements with wild fish. One of the chief problems confronting the fish-culturist at this location is the difficulty of preventing the entrance of coarse fish into the ponds through the water-supply intake and the admixture of the different species in the various ponds.

FAIRPORT (IOWA) STATION

[THOMAS K. CHAMBERLAIN, Director]

Practically all of the ponds at this station are being utilized for experimental work in pondfish culture, with special reference to the propagation and rearing of largemouth black bass. The primary object of these experiments, which are under the immediate supervision of Dr. A. H. Wiebe, is to work out the most practicable methods of rearing bass to fingerling size with a minimum amount of labor. It has been found that by stocking the ponds with forage fish and adding small amounts of fertilizer at frequent intervals during the spring and early summer as many as 10,000 3-inch fingerlings per acre can be produced at comparatively low cost. It has also been found that it is entirely feasible to rear brood bass in hatchery ponds, and additions to brood stock are now confined to fish that have been reared in the station ponds.

UPPER MISSISSIPPI WILD LIFE AND FISH REFUGE

In the spring of 1928 a study of conditions in the sloughs and ponds, which are characteristic of the bottom lands in the refuge, was undertaken by Eugene W. Surber. His investigations showed that a certain class of slough appears to offer favorable conditions for the propagation of bass and other pondfish. Several sloughs in the vicinity of Trempealeau, Wis., were selected for experimental work to determine the practicability of utilizing such ponds for fish-cultural purposes. With this object in view, the dense growth of willows and other vegetation along the margins of the sloughs was cleared away. The larger aquatic plants also were removed so as to permit the use of a seine to capture predacious fish, which would prey on the more desirable game fishes. Owing to the impossibility of obtaining brood fish, these ponds could not be used for the propagation of bass during the present season. Efforts are being made, however, to obtain a stock of brood fish for next year, which will be wintered in spring-fed ponds at Trempealeau.

Mr. Surber's investigations have shown that the sloughs are rich in food and are apparently capable of supporting a large fish population. One of the greatest problems is the control of the aquatic vegetation, which grows so rapidly in the shallow ponds as to offer a serious obstacle to fish-cultural work. Fortunately, preliminary experiments in treating the ponds with sodium arsenite indicate that it will probably be possible by this means to prevent excessive growth of aquatic plants without detrimental effect on the fish or their food.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. FEARNOW, Superintendent of Fish Distribution]

The output of fish and fish eggs by the bureau's stations—7,060,369,500—exceeded that of last year by nearly a quarter of a million. Greater outputs were had of shad, cisco, landlocked salmon, black-spotted trout, striped bass, haddock, pollock, and other species. That the output of fingerlings was not as large as it was in 1928 was due to the high stage of the water along the Mississippi River, which prevented rescue operations on a large scale during the summer and fall months. In 1928 the rescue fields yielded 158,154,200 fingerling fish, while in 1929 only 5,202,250 fish were obtained from this source. A large proportion of the fry and fingerlings was planted in waters in the vicinity of the hatcheries or released from the rearing stations nto streams without resorting to shipment by railroad. This is especially true of the commercial and rescued species.

Shipments of fish eggs were made to Canada, Cuba, Japan, Peru, and Switzerland, and a consignment of 250 fingerling smallmouth black bass was forwarded to Sweden. Ninety-five per cent of the year's output consisted of eggs and fry of the commercial species. Virtually all of these, with the exception of a comparatively few furnished the State fish commissions, were planted in the waters from which the eggs were obtained. Included in this classification are the buffalo fish, shad, glut herring, whitefish, cisco, salmon, lake trout, mackerel, pike perch, yellow perch, striped bass, cod, haddock, pollock, and winter flounder.

The species distributed to interior waters are the brook trout, rainbow trout, black-spotted trout, Loch Leven trout, golden trout, smallmouth black bass, largemouth black bass, crappie, rock bass, bream, and catfish. While the number of these species represents but a small per cent of the entire output, at the time of shipment such fish were quite large and their distribution was a difficult problem. Fry of the commercial species are carried 50,000 to 100,000 to the pail, while not more than one hundred 4-inch fish can be carried in one of the regulation containers.

The trout distribution was quite heavy, due to the greater number of cooperative stations and the tendency to rear trout at the bureau's stations (where facilities are available) until they are 3 or 4 inches in length. In addition to the general distribution of trout to applicants during the spring and early summer, approximately 20 carloads of trout were delivered to cooperative projects in Pennsylvania, West Virginia, Virginia, New York, Minnesota, Wisconsin, and New Hampshire.

The following table summarizes the distribution of fish and fish eggs during the fiscal year to applicants in the United States and its Territories. It also shows the plants of fish made by the bureau in public waters of the country in connection with the propagation of commercial fishes and the salvage of fish from temporarily flooded lands.

Summary, by species, of the distribution of fish, fiscal year 1929

State and species	Number
Alabama:	
Catfish	1,300
Largemouth black bass	299,275
Sunfish	61,215
Alaska: Sockeye salmon	46,084,715
Arizona:	
Catfish	300
Rainbow trout	6,000
Brook trout	10,000
Largemouth black bass	4,502
Rock bass	600
Sunfish	225
Arkansas:	
Rainbow trout	68,455
Crappie	875
Largemouth black bass	192,443
Smallmouth black bass	117,000
Rock bass	15,250
Sunfish	26,525
California: Chinook salmon	4,546,800
Colorado:	
Catfish	2,400
Rainbow trout	460,000
Black-spotted trout	146,125
Loch Leven trout	172,970
Brook trout	2,831,300
Crappie	720
Largemouth black bass	12,917
Rock bass	40
Sunfish	1,500
Yellow perch	1,000
Connecticut:	
Catfish	70
Rainbow trout	200
Brook trout	1,500
Crappie	100
Largemouth black bass	200
Smallmouth black bass	28,200
Yellow perch	360

Summary, by species, of the distribution of fish, fiscal year 1929—Continued

State and species	Number
Delaware:	
Rainbow trout	1,000
Largemouth black bass	975
Sunfish	600
District of Columbia:	
Rainbow trout	20
Brook trout	19
Crappie	260
Smallmouth black bass	560
Sunfish	260
Florida:	
Rainbow trout	430
Largemouth black bass	4,000
Smallmouth black bass	400
Sunfish	600
Georgia:	
Catfish	4,675
Rainbow trout	37,400
Brook trout	100,800
Largemouth black bass	277,425
Rock bass	600
Sunfish	62,600
Idaho:	
Chinook salmon	6,477,500
Rainbow trout	877,900
Illinois:	
Catfish	51,625
Buffalo fish	5,450
Carp	7,350
Crappie	12,018
Largemouth black bass	10,679
Sunfish	10,147
Yellow perch	498
Indiana:	
Catfish	400
Rainbow	33,800
Brook trout	24,600
Crappie	225
Largemouth black bass	16,000
Smallmouth black bass	139,200
Rock bass	700
Sunfish	17,085
Iowa:	
Catfish	365,092
Buffalo fish	29,255
Carp	22,895
Rainbow trout	17,120
Brook trout	21,900
Pike and pickerel	22,301
Crappie	957,453
Largemouth black bass	21,293
Smallmouth black bass	1,050
Sunfish	244,608
Pike perch	373
Yellow perch	2,410
White bass	302
Kansas:	
Catfish	450
Crappie	1,300
Largemouth black bass	5,145
Rock bass	5,000
Sunfish	2,575
Yellow perch	4,500
Kentucky:	
Largemouth black bass	2,700
Smallmouth black bass	457,400
Rock bass	1,425
Sunfish	2,325
Louisiana:	
Largemouth black bass	18,650
Rock bass	1,800
Sunfish	2,225
Maine:	
Landlocked salmon	516,850
Atlantic salmon	725,350
Brook trout	1,793,350
Smallmouth black bass	9,358
Winter flounder	2,011,009,000
Maryland:	
Shad	30,681,000
Cisco	1,000,000
Chinook salmon	4,000
Maryland—Continued.	
Rainbow trout	21,300
Loch Leven trout	7,200
Brook trout	16,800
Crappie	650
Largemouth black bass	2,605
Smallmouth black bass	29
Rock bass	600
Sunfish	7,000
Massachusetts:	
Catfish	8,998
Rainbow trout	2,420
Loch Leven trout	900
Brook trout	160,155
Mackerel	2,778,000
Crappie	100
Largemouth black bass	310
Smallmouth black bass	5,500
Sunfish	2,524
White perch	340
Cod	274,853,000
Pollock	358,442,000
Winter flounder	783,327,000
Michigan:	
Whitefish	25,408,800
Steelhead salmon	29,800
Rainbow trout	201,975
Lake trout	34,621,000
Brook trout	537,000
Smallmouth black bass	70,000
Pike perch	2,015,000
Minnesota:	
Catfish	174,450
Carp	1,010
Whitefish	300,000
Cisco	400,000
Rainbow trout	79,790
Loch Leven trout	97,420
Lake trout	472,500
Brook trout	217,100
Pike and Pickerel	12,500
Crappie	845,100
Largemouth black bass	3,479
Sunfish	1,362,680
Pike perch	4,000,000
Yellow perch	107,740
White bass	30
Fresh-water drum	2,850
Miscellaneous fishes	660,000
Mississippi:	
Catfish	750
Largemouth black bass	471,255
Sunfish	85,760
Missouri:	
Rainbow trout	133,245
Crappie	6,880
Largemouth black bass	57,062
Smallmouth black bass	525
Rock bass	3,000
Sunfish	13,250
Yellow perch	1,000
Montana:	
Rainbow trout	1,089,580
Golden trout	9,000
Black-spotted trout	882,375
Loch Leven trout	379,000
Brook trout	219,255
Grayling	1,750,000
Crappie	678
Largemouth black bass	942
Sunfish	612
Nebraska:	
Catfish	4,050
Rainbow trout	34,900
Loch Leven trout	17,000
Brook trout	21,300
Largemouth black bass	14,650
Sunfish	4,025
Nevada:	
Rainbow trout	110,000
Brook trout	12,000

Summary, by species, of the distribution of fish, fiscal year 1929—Continued

State and species	Number
New Hampshire:	
Catfish	420
Landlocked salmon	9, 600
Rainbow trout	12, 197
Brook trout	287, 498
Smallmouth black bass	5, 500
Pike perch	200, 000
New Jersey:	
Catfish	1, 825
Rainbow trout	4, 150
Loch Leven trout	1, 350
Brook trout	10, 600
Largemouth black bass	6, 245
Smallmouth black bass	3, 450
Sunfish	240
New Mexico:	
Catfish	5, 300
Carp	250
Rainbow trout	39, 000
Black-spotted trout	4, 000
Brook trout	219, 000
Largemouth black bass	9, 160
Sunfish	5, 000
Yellow perch	440
New York:	
Catfish	279
Whitefish	22, 705, 000
Cisco	116, 000, 000
Rainbow trout	169, 375
Loch Leven trout	12, 700
Lake trout	2, 365, 490
Brook trout	762, 323
Largemouth black bass	3, 000
Smallmouth black bass	375
Sunfish	5, 000
Pike perch	2, 100, 000
North Carolina:	
Catfish	109
Shad	6, 500, 000
Glut herring	11, 500, 000
Rainbow trout	90, 810
Loch Leven trout	118, 450
Brook trout	176, 700
Crappie	1, 370
Largemouth black bass	70, 100
Rock bass	8, 575
Warmouth bass	75
Sunfish	46, 645
Yellow perch	1, 200, 575
Striped bass	9, 661, 000
Ohio:	
Carp	2, 500, 000
Whitefish	45, 981, 000
Rainbow trout	4, 000
Loch Leven trout	2, 700
Brook trout	23, 000
Crappie	2, 500
Largemouth black bass	8, 070
Sunfish	125
Pike perch	23, 000, 000
Yellow perch	18, 000, 000
Oklahoma:	
Catfish	6, 370
Rainbow trout	6, 440
Crappie	2, 270
Largemouth black bass	29, 800
Rock bass	1, 560
Sunfish	15, 385
Yellow perch	1, 410
Oregon:	
Chinook salmon	7, 374, 600
Sockeye salmon	68, 000
Silver salmon	778, 400
Chum salmon	777, 000
Steelhead salmon	125, 000
Rainbow trout	192, 400
Black-spotted trout	20, 000
Brook trout	165, 400
Pennsylvania:	
Catfish	5, 740
Rainbow trout	367, 375
Loch Leven trout	153, 050
Brook trout	1, 178, 880
Pennsylvania—Continued.	
Crappie	8, 464
Largemouth black bass	29, 677
Smallmouth black bass	1, 250
Rock bass	150
Sunfish	16, 430
Yellow perch	54
Rhode Island:	
Catfish	52
Rainbow trout	50
Brook trout	50
South Carolina:	
Rainbow trout	20, 700
Brook trout	43, 200
Crappie	600
Largemouth black bass	303, 775
Rock bass	1, 500
Warmouth bass	5, 790
Sunfish	16, 760
South Dakota:	
Catfish	1, 330
Rainbow trout	149, 750
Loch Leven trout	117, 800
Brook trout	329, 710
Largemouth black bass	125
Sunfish	300
Tennessee:	
Rainbow trout	93, 200
Loch Leven trout	20, 800
Brook trout	32, 800
Largemouth black bass	71, 560
Smallmouth black bass	2, 000
Rock bass	2, 920
Sunfish	7, 960
Texas:	
Rainbow trout	18, 060
Crappie	11, 620
Largemouth black bass	186, 429
Rock bass	2, 170
Warmouth bass	15
Sunfish	42, 080
Utah:	
Rainbow trout	1, 382, 400
Brook trout	472, 000
Vermont:	
Steelhead salmon	1, 029
Landlocked salmon	19, 214
Rainbow trout	40, 037
Loch Leven trout	954
Brook trout	463, 665
Smallmouth black bass	500
Pike perch	13, 400, 000
Yellow perch	7, 700, 000
Virginia:	
Catfish	409
Shad	34, 170, 000
Rainbow trout	298, 600
Loch Leven trout	5, 400
Brook trout	232, 275
Crappie	6, 685
Largemouth black bass	41, 795
Smallmouth black bass	19, 000
Rock bass	20, 325
Sunfish	18, 990
Yellow perch	166, 023, 000
Washington:	
Chinook salmon	19, 810, 300
Chum salmon	19, 202, 000
Silver salmon	7, 207, 635
Sockeye salmon	3, 264, 200
Steelhead salmon	2, 973, 000
Rainbow trout	24, 200
Black-spotted trout	15, 500
Brook trout	93, 000
West Virginia:	
Rainbow trout	923, 939
Loch Leven trout	172, 065
Brook trout	864, 874
Crappie	12, 250
Largemouth black bass	6, 250
Rock bass	2, 054
Sunfish	12, 250

Summary, by species, of the distribution of fish, fiscal year 1929—Continued

State and species	Number	State and species	Number
Wisconsin:		Wyoming:	
Catfish	1,500	Catfish	150
Whitefish	200,000	Rainbow trout	538,990
Cisco	5,600,000	Black-spotted trout	5,874,415
Rainbow trout	382,490	Loch Leven trout	214,570
Loch Leven trout	68,180	Brook trout	943,380
Lake trout	12,000	Crappie	160
Brook trout	899,170	Largemouth black bass	4,655
Crappie	14,900	Sunfish	500
Largemouth black bass	2,485	Yellow perch	1,250
Smallmouth black bass	3,372		
Sunfish	11,605		
Pike perch	1,200,000		
Yellow perch	1,725		

METHOD OF DISTRIBUTION

In making the distribution of fish to from 12,000 to 15,000 applicants annually the bureau aims so to apportion the output of its hatcheries as to obtain the best results, giving special consideration to waters in which the fish will have an opportunity to mature and reproduce. In pursuance of this plan many difficulties are encountered, the chief of which is the insistence of applicants to obtain some favorite species regardless of whether or not the waters are suitable therefor.

It is the policy to supply first the waters from which the eggs are collected, after which shipments are made to suitable public and private waters on application submitted previously. Blanks on which formal applications may be made are furnished to applicants on request. Such blanks call for a complete description of the waters to be stocked, and from the information supplied the bureau assigns the species that are suitable.

Applicants are notified immediately as to the species that will be sent them and the approximate date of delivery, and they are given instructions for receiving and caring for the fish. Before shipment is made a second notice is given, usually by telegram, stating the exact time of arrival of the fish at the railroad station. The fish are delivered to the applicant's railroad station free of charge, and in the event that the shipment is delayed the applicant is notified accordingly.

Fish usually are shipped in carload lots to central points, and messengers leave the cars at various points to make deliveries to applicants whose railroad stations are located on branch lines. These messengers travel in the baggage cars of passenger trains, and deliveries must necessarily be made when the train makes its customary stops. A messenger often has a dozen or more deliveries to make before rejoining his car and must return his full quota of pails immediately in order that further shipments may be made in accordance with the prearranged schedule. As the pails are a part of the car's equipment, it is obvious that if they were lent to applicants it would necessitate a suspension of the bureau's work until they were returned. Applicants are expected to provide suitable receptacles for carrying fish, such receptacles to be in readiness at the railroad station specified in the advance notice of delivery. The vessels should be uncovered and empty.

In making allotments of fish on applications the following items are taken into consideration: Area of water to be stocked, as stated in the application; size and number of fish available for distribution; and the distance the fish must be transported. The bureau distributes fish as fingerlings or yearlings. At some stations, however, it is necessary to distribute a portion of the output as fry in order to prevent overcrowding.

The basses, sunfishes, and other pondfishes are distributed from three weeks to several months after they are hatched. The basses usually range from 2 to 6 inches in length, and the sunfishes from 2 to 4 inches in length. Commercial fishes, such as whitefish, yellow perch, etc., are produced in large numbers and are necessarily planted as fry. As a general rule the bureau delivers fish in the order in which the applications are received, and applications remain on file until delivery of the desired fish can be made.

Shipments of trout from the bureau's eastern stations are usually made during May and June, and applications received after April 1 will be carried on file for attention during the following year. The distribution of trout from stations in the Rocky Mountain region is made from May to October, and applications from that section should be submitted prior to May 1 in order to assure early delivery. Requests for bass, sunfish, and crappie should be on file with the bureau prior to May 1, as deliveries of such species are made between May and December.

During the year the bureau's cars traveled 79,646 miles, of which 1,828 were free. Detached messengers traveled 286,040 paid and 80,239 free miles, a total of 346,279 miles.

ORNAMENTAL FISHES, TOP MINNOWS, ETC.

The bureau receives frequent applications for goldfish and other ornamental fishes, also numerous inquiries pertaining to the construction of pools for goldfish and water lilies. As the bureau's fish-cultural activities are addressed to the propagation of the food fishes, its appropriation being specifically designated as for that purpose, it can not undertake to furnish applicants with the ornamental species.

Within recent years the demand on the bureau for information on ornamental fishes has increased to the point where it has been necessary to provide publications in order to handle such inquiries expeditiously and economically. Document No. 980, which deals with the care of goldfish in small aquaria and ponds, was published some years ago and may be purchased for 5 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. Just recently Economic Circular No. 68, dealing with the goldfish industry, was released and is now procurable from the Superintendent of Documents for 5 cents. This circular contains such information as was obtainable from the goldfish producers in regard to the types of goldfish cultivated, their value, distribution, etc. It also contains a list of goldfish breeders and jobbers. The bureau has no complete treatise on ornamental fishes, but excellent advice on the subject may be obtained from standard publications, which may be consulted in public libraries. Furthermore, books on ornamental fishes, containing information on the care of goldfish and tropical fishes, are now sold at bookstores. Practically all standard books on goldfish give information on the construction of pools for goldfish and water lilies.

The bureau does not propagate the top minnow (*Gambusia patruelis*), a fish that is in great demand for holding mosquitoes in check, being particularly fond of the larvæ or "wigglers." Persons interested in stocking stagnant pools with top minnows will, upon inquiry of the bureau, be furnished a list of dealers in this species.

The top minnow is a semitropical fish, being found in stagnant ponds in the Southern States as far north as southern Maryland. Persons living within the range of these minnows should be able to obtain their supplies from local waters.

The top minnow will not survive a northern winter in open waters, so where the winter is severe it is advisable to introduce fishes of the smaller varieties, as any top-feeding fish will feed on mosquito larvæ. The bureau's Document No. 923, Use of Fishes for Control of Mosquitoes in Northern Fresh Waters of the United States, is available only from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents.

While it is recognized that in fish culture, especially in bass culture, it is necessary to provide an ample supply of living food, the bureau is not in position to furnish a brood stock of minnows for forage purposes. Practically all minnows are very prolific, and a few golden shiners introduced into a pond will multiply quite rapidly. A stock of a suitable variety of fish for forage purposes often can be collected from local waters. The common sunfish, or a pumpkin seed, and uncolored goldfish are frequently used for forage purposes.

NEW STEEL CAR

The 1928 appropriation carried an item of $60,000 for the construction and equipment of a steel railway car to take the place of car No. 4, which was condemned during the year and turned over to the District of Columbia for use at one of its institutions. In December, 1928, the bureau advertised for bids, and early in February the contract was awarded to the lowest bidder, the Bethlehem Steel Corporation, Harlan Plant, Wilmington, Del., the contract price being $59,000.

The new car will be approximately 70 feet over end sheets, with 4-foot platforms at each end, similar to those used on observation cars. The length, from buffer to buffer, will be approximately 81 feet. It will be designated "Bureau of Fisheries Car No. 10" and will probably be completed and in commission by December, 1929. This car will be strictly modern in every respect, affording the best possible accommodations for the crew, and will have insulated compartments of sufficient capacity to hold 325 of the bureau's standard fish containers. Its capacity load will range from 35,000 3-inch fish to 500,000 1-inch fish. An axle generator will charge the batteries, which have a capacity of 750 ampere-hours of 32 volts, sufficient power to light the car and operate the electric aerating plant.

FISH TRANSPORTATION

The transportation of the bureau's output of fish was accomplished with practically no loss. While a few fish succumb during transportation, due to injuries received in the collection or in transferring to the containers, the bureau has not had a large loss of fish for a number of years.

The distribution cars are fitted with steam and electric air compressors for forcing air into the water in which the fish are carried. However, messengers on detached shipments have to resort to other methods for aeration, usually dipping or agitating the water.

Within recent years it has been demonstrated that temperature is the most important factor in the successful handling of living fish and that excessive dipping often does more harm than good by exciting the fish, thereby causing them to use more oxygen than the water will hold in solution. The practice of constantly dipping and stirring up sediment has been reduced gradually to a minimum, and more attention is now paid to maintaining an even water temperature. In fact, the distribution cars often turn off the air pressure in the containers when the train is in motion, depending upon the agitation of the water caused by the motion of the train and the spontaneous absorption of oxygen by the water.

Some years ago three attempts were made to send a messenger shipment of trout from Virginia to Maine. The first two efforts met with complete failure. At that time aeration by dipping was practiced to the limit and little attention was paid to water temperature. The attendants stood by the fish constantly, dipping out water and pouring it back. Last June messenger shipments of brook trout (10 and 12 inch fish) were sent from Maine to Virginia, being en route 48 hours. Each messenger carried 35 pails of fish, an average of 6 fishes per pail, and not a single fish was lost while in transit. These messengers watched the water temperature closely, and on each trip the fish were aerated but once, which was during a lay-over in Philadelphia. With a minimum of disturbance the fish rested comfortably on the bottom of the containers, requiring very little oxygen.

Excessive agitation of the water by dipping or other means will cause the fish to exercise themselves to the point of exhaustion. For this reason the cans should be well covered and not disturbed except when absolutely necessary. Ordinarily, a 5-gallon pail of water at 60° will, if sufficient water surface is exposed to the air, absorb from the air enough oxygen to maintain 75 3-inch bass in a quiet state for three or four hours. The bureau's messengers have practically discarded the dipper, and at railroad junctions place the fish on express trucks and move the truck occasionally to aerate the water.

The liberation of too much compressed air in the water has a disastrous effect on small fish, the little ones being unable to withstand the boiling motion of the water. In the new distribution car special attention has been paid to providing means for controlling the water temperature.

RESCUE OPERATIONS

For years the bureau has depended on fish salvaged from the landlocked ponds and pools along the Mississippi River for pondfishes for filling applications in the upper Mississippi Valley. Last year was an off season, the Mississippi River remaining high during the summer and fall, so that no fish could be collected for shipment from sources that in the previous year yielded approximately 150,000,000 fish.

Regardless of the failure to obtain fish at the rescue stations, the distribution cars were kept in active service until late in the fall. The Langdon (Kans.) station, after completing its distribution, had a surplus of two carloads of bass, crappie, etc., which was shipped to Ohio and Indiana. The Fairport (Iowa) station provided two carloads of bass for waters ordinarily supplied from the rescue stations, and the output of the Lakeland (Md.) ponds was widely distributed in waters of Virginia, Maryland, West Virginia, New Jersey, and Delaware. The project at Miles City, Mont., yielded a fair output for the first year of its operation, and with a greater number of brood fish much better results are expected in the fall of 1929.

GOLDEN TROUT

For the first time the bureau's records show a distribution of the golden trout of Mount Whitney, the most beautiful of all our western trouts. It is an inhabitant of small mountain streams on the western slope of Mount Whitney, a tributary of Kern River, and is abundant in Volcano Creek and the South Fork of Kern River. The golden trout, while small, is remarkable for its gameness and unsurpassed beauty.

This species is listed in Jordan and Everman's American Food and Game Fishes, under the scientific name *Salmo agua-bonita*. In 1906 this beautiful trout was brought to the attention of Theodore Roosevelt, then President, who immediately got in touch with the bureau with the view of propagating the species. One of the distribution cars was ordered to Nevada, and arrangements were made with employees of the Baird (Calif.) station to make a collection of adult fish. Considerable trouble was experienced in transporting the fish from Volcano Creek to the railroad station at Mina, Nev., as the only means of transportation was by pack horses. Finally, a carload of golden trout, which recent writers designate *Salmo roosevelti*, was assembled and sent to Leadville, Colo., and Bozeman, Mont. The fish were propagated to some extent, but the fry inadvertently became mixed with the fry of the rainbow trout, and for various reasons the matter of propagating this species was neglected until within recent years. The shipment of 9,000 golden trout, 1½-inch fish, was delivered to the United States Forest Service and planted in high-altitude waters.

COOPERATION WITH THE UNITED STATES FOREST SERVICE

When we think of forests to-day we not only visualize trees and land mammals but fish as well. The great recreation grounds of the present and future furnish an environment congenial equally to game and fish. The trees, which provide a cover for game, hide many waters rich in natural food, where fish may propagate and the young develop and eventually drop down the streams to where they may be caught by the angler. Forests are the prime requisities for clear, cool streams with an even flow of water and suitable for the most desirable game fishes.

In line with the general demand for good fishing and the recognized importance of forests in relation to fish life, the Forest Service is actively cooperating with the United States Bureau of Fisheries and the fisheries authorities of the States in order to secure better plantings. The following table gives the species and number of fish planted by forest officers of the Rocky Mountain district in 1928:

State and forest	Black-spotted trout	Brook trout	Rain-bow trout	Loch Leven trout	Rock bass	Silver salmon	Perch	Blue-gill	Small-mouth black bass	Total
Colorado:										
Arapaho	19, 575	--------	7, 200	--------	--------	--------	--------	--------	--------	26, 775
Cochetopa	44, 000	65, 600	--------	--------	--------	--------	--------	--------	--------	109, 600
Colorado	18, 750	248, 000	54, 000	--------	--------	--------	--------	--------	--------	320, 750
Gunnison	430, 500	228, 000	117, 500	--------	--------	20, 000	--------	--------	--------	796, 000
Holy Cross	67, 000	462, 000	--------	--------	--------	--------	--------	--------	--------	529, 000
Leadville	73, 000	10, 450	--------	--------	--------	--------	--------	--------	--------	83, 450
Montezuma	4, 000	184, 000	170, 000	--------	--------	--------	--------	--------	--------	358, 000
Pike	--------	82, 600	--------	--------	--------	--------	--------	--------	--------	82, 600
Rio Grande	401, 500	247, 000	430, 500	8, 000	--------	--------	--------	--------	--------	1,087,000
Routt	45, 000	--------	2, 500	--------	--------	--------	--------	--------	--------	47, 500
San Isabel	55, 000	--------	97, 000	--------	--------	--------	--------	--------	--------	152, 000
Uncompahgre	5, 000	33, 000	--------	--------	--------	--------	--------	--------	--------	38, 000
Michigan: Huron	--------	342, 000	50, 000	--------	--------	--------	9, 500	3, 000	3, 000	407, 500
Oklahoma: Wichita	--------	--------	--------	--------	8, 000	--------	--------	--------	--------	8, 000
South Dakota:										
Black Hill	--------	46, 000	--------	--------	--------	--------	--------	--------	--------	46, 000
Harney	--------	50, 000	--------	--------	--------	--------	--------	--------	--------	50, 000
Wyoming:										
Bighorn	190, 000	--------	--------	--------	--------	--------	--------	--------	--------	190, 000
Hayden	49, 600	97, 000	--------	--------	--------	--------	--------	--------	--------	146, 600
Medicine Bow	446, 400	242, 000	--------	20, 000	--------	--------	--------	--------	--------	708, 400
Shoshone	90, 000	453, 500	--------	--------	--------	--------	--------	--------	--------	543, 500
Washakie	--------	1, 700	1, 700	--------	--------	--------	--------	--------	--------	3, 400

The total number of fish planted by the forest officers is 5,735,075. In addition to the above, 4,490,500 were planted by other agencies. The totals do not include plants made in the forest by cooperative agencies, clubs, associations, and private parties.

Excellent relations exist between the Forest Service and the Bureau of Fisheries as well as with the various States. While forest rangers frequently are difficult to reach, due to the nature of their work, which calls them to points far away from civilization, there are not many instances of failures to meet fish, as it is generally understood that notice of deliveries must be sent far in advance of shipments.

The forest rangers meet the fish-distribution cars at designated railroad stations and transport the fish to the streams and lakes, sometimes far into the mountains, and often requiring the use of pack horses, the roads being inaccessible for other methods of conveyance. The following comments, taken from the report of District Forester Allen A. Peck, will give an idea of what is being done in the Rocky Mountain forests to maintain good fishing:

Supervisor Leighou, of the Arapaho National Forest, reports that fry are held in nursery ponds and systematically fed until they reach a sufficient size to care for themselves in open waters.

Supervisor Mack, of the Cochetopa National Forest, states that trout fishing in the Arkansas in and adjacent to Salida is reported by the oldtimers to have been better in the past season than for many years. He attributes this to a retaining pond in the forest 3 miles above Salida, where fry are kept until large enough to withstand the swift water of the streams and to cope with the large fish.

Ranger Ware, of the Colorado Forest, makes mention of a new $75,000 State reservoir that has been stocked with rainbow trout for the purpose of providing spawn. He further states that dwellings and 60 rearing troughs were built in 1928, and that it is thought that as many as 20,000,000 eggs will be taken from this lake annually.

In writing of Grand Mesa Forest, Supervisor Peck states that the new fish hatchery at Alexander Lakes has been built and will be ready to receive eggs in the fall of 1929. He reports that 3,000,000 eggs of the rainbow, yellow-fin, and black-spotted trout were taken at the Grand Mesa Lakes last spring and over 1,000,000 eggs of the eastern brook trout in the fall.

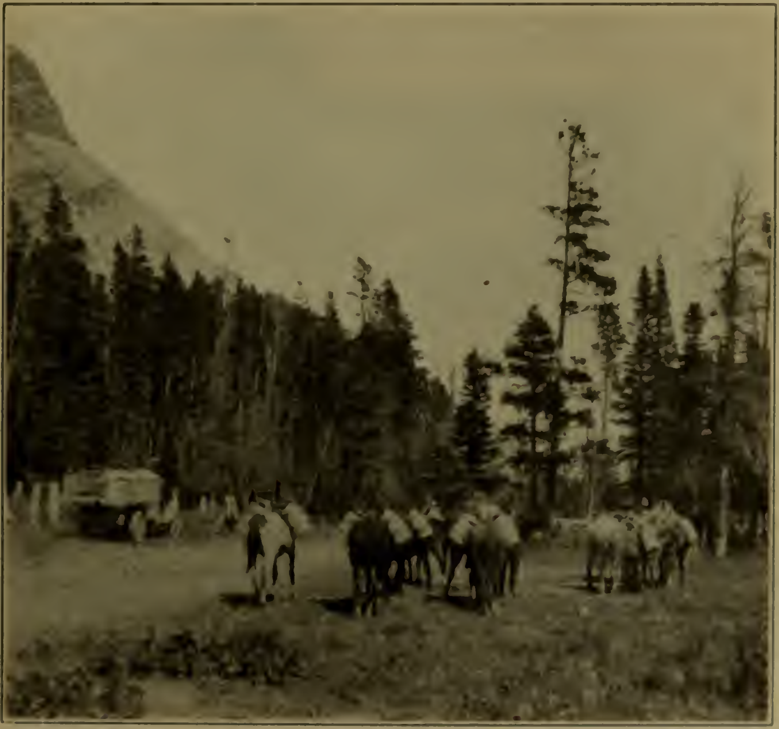

FIGURE 1.—The fish are hauled from the railroad station to where the mountain trails begin and are loaded on pack horses

Supervisor Krueger, of the Gunnison Forest, advises that the salmon trout introduced into Mirror Lake in 1925 made exceptional growth and in 1927 averaged 10 inches in length, but the slow growth of these fish since 1927 indicates that the supply of food is inadequate.

Junior Range Examiner Stell, Montezuma National Forest, reports large plants of fish but no efforts to screen the head gates of irrigation ditches; consequently, many fish find their way into these ditches and perish when the water is turned off. He also reports many retaining ponds under construction by sportsmen's clubs.

Supervisor Hutton, of San Juan, reports a spawn-taking station established in 1928 by the State of Colorado and the creation of a lake of approximately 100 acres, which has been stocked and is to be used exclusively as a rainbow-trout egg-collecting station.

The activities of the Izaak Walton League and other sportsmen's associations are manifested to a considerable degree in fish planting in the Black Hills. Nursery ponds were constructed in the Harney Forest, the fry doing very well under the care of the local members of the Izaak Walton League.

The bureau maintains a hatchery in Yellowstone National Park, which is concerned with the propagation of species indigenous to the waters of the park, and close cooperation exists between the bureau's representative and the park authorities. Similar relations also exist with the authorities of the Glacier National Park, where large plants of trout are made each year.

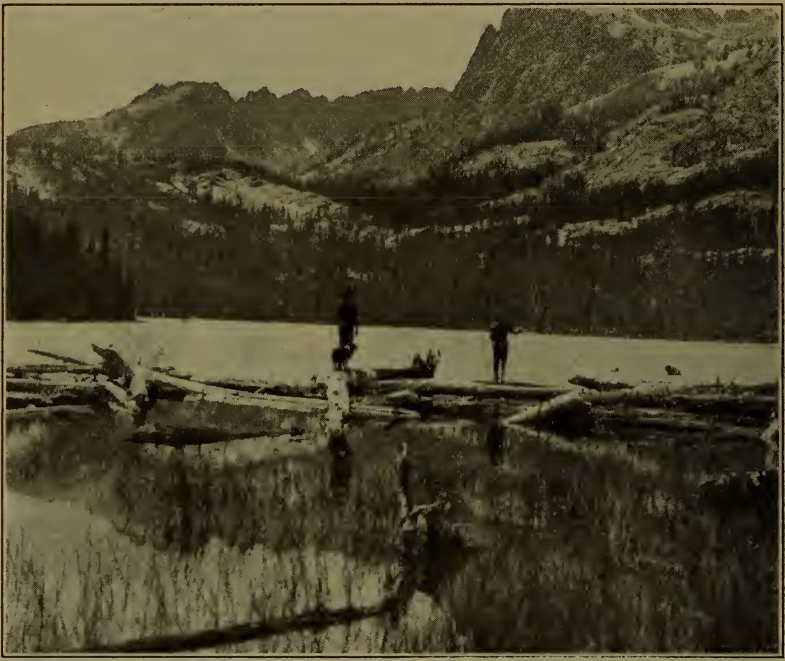

FIGURE 2.—Fishing in one of the isolated mountain lakes. Small trout are abundant in the log drift

The chain of national forests extending from Maine and New Hampshire on the north, Florida on the south, and Arkansas on the west contains thousands of miles of good fishing water. The bureau, in cooperation with the United States Forest Service, is making a consistent effort to increase the fish life in these streams in order that they may contribute to the recreation and enjoyment of fisherman throughout the region. To accomplish this objective requires the annual planting of fish in those waters in which the natural increases are not sufficient to maintain good fishing.

The Forest Service cooperates closely with the bureau, from which the planting stock is procured, and with the various State fish and game commissions, in the fish-cultural work, which is of a highly specialized nature. The actual planting work is accomplished by the helpful cooperation of the local fish and game associations, and through the services of the local forest officers. The beneficial results of this form of cooperation, which has been carried on for a number of years, now are clearly evident.

During the past year the bureau has furnished the Forest Service, for planting in the streams in the national forests of the East, a total of 413,700 brook trout, 218,500 rainbow trout, and 47,700 black bass.

It is now a well-recognized fact that successful fish plantings can not be made in all cases by the use of fry. Indeed, each stream must be studied in order to determine both the species and size of fish necessary to secure economic results. In view of this, an ever increasing number of fingerlings is now being used. In some cases rearing pools have been constructed, and the fish, before being planted, are fed until they are 4 to 5 inches long.

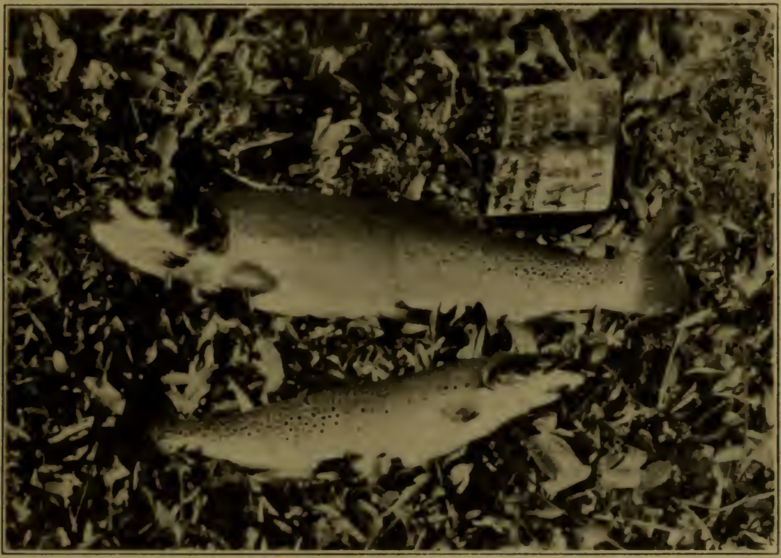

FIGURE 3.—Black-spotted trout are abundant in the Rocky Mountains and are commonly known in that region as cut-throat trout

The streams of the eastern national forests contain many miles of fishing waters, which are open to the public under the laws of the States in which they are located. To date, however, the work of stocking can only be considered as a start in the right direction. While some of the difficulties of successful fish-planting work have been solved, new problems are continually coming to light.

The bureau, with its experience and continuous research work, is consulted and its advice sought. It is believed more progress will result in the future, especially if the bureau is able to increase the capacity of its hatcheries to take care of the ever increasing demand for fish-planting stock.

From the foregoing it will be seen that the matter of fish propagation and fish planting is regarded by the Forest Service as one of its most important game problems.

DISTRIBUTION CARS

CAR NO. 3

[T. H. COPELAND, Acting Captain]

At the beginning of the fiscal year car No. 3 was completing the cooperative distribution from the La Crosse (Wis.) station and assisting with the distribution from the Manchester (Iowa) station. From July 2 to 12 messengers from the car moved 43,000 brook trout from the La Crosse hatchery to cooperative nurseries at Eau Claire, Boscobel, Merrill, Stanley, Osseo, Arcadie, and Tunnel City, Wis., which completed the trout distribution from La Crosse for the year. On July 17 the car loaded at the Manchester (Iowa) station and delivered the fish to applicants in northern Wisconsin, returning to La Crosse, where the crew was engaged in overhauling the equipment of car.

On September 29 the car left La Crosse for the Fairport station and at that point took up the distribution of bass and bream, moving three carloads of these species to waters in Iowa, Minnesota, Wisconsin, Ohio, and Pennsylvania, and returning to La Crosse on October 17. On November 1 the car left for Langdon, Kans., and obtained a carload of fish for applicants in Ohio and adjacent states. The car left Columbus, Ohio, on November 8 and arrived at La Crosse on November 9, where the crew, with the exception of the captain, was detailed to hatcheries to assist in the propagation of fish.

On January 2 the car was moved from La Crosse to the Milwaukee shops for general repairs.

On March 13 the car moved 194,716 trout from the La Crosse station to the Lynxville (Wis.) substation to be reared to fingerling size, the car returning to La Crosse on March 14. On May 6 the distribution of trout was begun at the La Crosse and Lynxville stations and completed on June 13. During this period six trips were made from La Crosse and Lynxville to points as follows: Tomahawk, Eau Claire, Stevens Point, and Neshkora, Wis., and Winona and St. Charles, Minn., delivering 218,300 fingerling brook trout, 149,500 fingerling rainbow trout, and 114,900 fingerling Loch Leven trout to cooperative nursery ponds. Messengers made detached trips from the car and delivered from the La Crosse and Lynxville stations 117,000 fingerling brook trout, 30,000 fingerling rainbow trout, and 16,000 Loch Leven trout to cooperate nursery ponds.

On June 17 the car left La Crosse for the Manchester (Iowa) station to take up the distribution from that point, moving two carloads of fish to points in Iowa, Wisconsin, and Minnesota and returning to Manchester before the close of the fiscal year.

The car traveled 11,239 miles over 8 railroad lines and delivered fish in 12 States during the fiscal year 1929. Detached messengers made 70 trips, traveling approximately 25,000 miles, and delivering fish in 16 States. The following tabulation will show the number, size, and species of fish delivered.

Species	Fingerlings No. 1	Fingerlings No. 2	Fingerlings No. 3	Fingerlings No. 4	Adults and yearlings
Catfish			2, 250		
Rainbow trout		271, 000			6
Loch Leven trout		130, 900			6
Brook trout	104, 140	476, 500			6
Crappie		1, 780	8, 790		
Largemouth black bass	552		23, 760	8, 830	247
Smallmouth black bass		3, 675			
Sunfish		2, 615			500
Total	104, 692	886, 470	34, 800	8, 830	765

CAR NO. 7

[E. R. WIDMYER, Captain]

At the beginning of the fiscal year car No. 7 took up the distribution of rainbow and brook trout from the Manchester (Iowa) station, making three trips to points in Wisconsin and delivering 184,200 2-inch brook trout and 41,900 1½-inch rainbow trout. After completing the three car trips, two messenger shipments were made from the Manchester station to Neshkora, Wis., to deliver 27,450 fingerling rainbow trout.

On August 28 the car left Dubuque with 3,789 warm-water fishes for applicants in New Hampshire, Massachusetts, and Connecticut. After delivery the car proceeded to Bucksport, Me., to take up the distribution of trout and salmon from the East Orland (Me.) station. From September 6 to 20 the car made four trips from Bucksport, distributing 49,000 fingerling Atlantic salmon, 82,500 fingerling brook trout, and 19,700 fingerling landlocked salmon.

The car was ordered from East Orland to Watertown, N. Y., arriving there September 20. From September 21 to October 18 two car trips and 35 messenger shipments were made from Watertown, delivering 258,600 fingerling brook trout and 83,650 fingerling rainbow trout to applicants in New York State.

On completion of the Watertown work the car left for Langdon, Kans., where a carload of the warm-water species was obtained and taken to Indianapolis. After delivering 31,315 warm-water fishes to applicants the car returned to Dubuque arriving there on October 27.

During the winter months two car trips and one messenger shipment were made from Lynxville, Wis., to Miles City, Mont., delivering 2,147 adult pondfishes to the Miles City cooperative station. After completing the two car trips the car returned to Dubuque, where it was held on the Illinois Central Railroad Co.'s tracks during the remaining winter months. While the car was at Dubuque the crew went over the pails and aerating equipment, placing them in readiness for further distribution work.

The spring distribution work was begun from Manchester on April 27, when a messenger left with 100 yearling rainbow trout for the Northville (Mich.) station. The car left Manchester on May 1 with 123,600 1½-inch brook trout, 8,500 1½-inch rainbow trout, and 3,325 3-inch smallmouth black bass. After delivering these fish to Wisconsin applicants the car returned to La Crosse, where it obtained 29,700 fingerling Loch Leven trout, 38,500 fingerling rainbow trout, and 24,000 fingerling brook trout, which were delivered to applicants in Minnesota, Wisconsin, and Michigan.

On completion of the trip from La Crosse the car proceeded to Duluth, Minn., to take up the distribution of lake trout, pike perch, and brook trout from that station. Seven car trips, five boat trips, and a large number of messenger shipments were made from Duluth, delivering 12,526,000 lake-trout fry, 636,500 fingerling lake trout, 8,210,000 pike-perch fry, 149,000 1-inch brook trout, and 5,050 2-inch rainbow trout.

Immediately on completion of the distribution at Duluth the car was ordered to La Crosse with instructions to obtain applications from car No. 3 and proceed with the distribution. One car trip was made from Manchester to Wisconsin applicants, and three messenger shipments were made to Wisconsin and Minnesota cooperative stations, delivering 88,900 fingerling brook trout and 70,500 fingerling rainbow trout. A new set of Exide storage batteries was installed on the car in June.

During the fiscal year 1929 car No. 7 made 24 trips, traveled 18,376 miles, and delivered 22,697,995 fish. Messengers made 112 side trips and traveled 29,874 miles. The following table shows the number and species of fish delivered:

Species	Fry	Fingerlings	Yearlings	Adults
Catfish		1,520		75
Atlantic salmon		49,000		
Landlocked salmon		19,700		
Rainbow trout		275,550	100	
Loch Leven trout		29,700		
Lake trout	12,526,000	636,500		
Brook trout		910,850		
Crappie		950		678
Largemouth black bass		12,740	241	645
Smallmouth black bass		3,325		
Rock bass		700		
Sunfish		18,725	24	612
Pike perch	8,210,000			
Yellow perch		360		
Total	20,736,000	1,959,620	365	2,010

CAR NO. 8

[K. P. IRWIN, Acting Captain]

The car left Portland, Me., early in July and arrived at Bozeman, Mont., on July 15 to handle the output of trout from the hatchery at that place. The next day the car left with a special consignment of rainbow, black-spotted, and brook trouts assigned to the various waters in Glacier National Park. Another such trip was made to Glacier Park, and one was made to Yellowstone National Park later in the season. Trips for the purpose of supplying regular and Forest Service applications were made to Noxon, Missoula, and Lewistown, Mont., and Casper, Lander, and Newcastle, Wyo.

In making the distribution from the Bozeman (Mont.) station the car handled rainbow, black-spotted, Loch Leven, and brook trouts. It left Bozeman and arrived at Dubuque, Iowa, on August 30. Orders were received to proceed to Marquette, Iowa, to assist in the distribution of the warm-water fishes collected at the rescue station at that point. Several detached messenger trips were made from the Marquette station to points in Minnesota, Iowa, and Wisconsin. The species carried were catfish, crappie, largemouth black bass, sunfish, and yellow perch.

On September 20 the car left Marquette for La Crosse, Wis., where repairs were made to the running gear. The car left La Crosse on October 3 and arrived at Fairport, Iowa, on October 5, where a load of warm-water fishes was procured, and the car proceeded to St. Louis, Mo., to make delivery of these fish to points in Illinois and Missouri. On completion of this work the car left St. Louis and arrived in Tupelo, Miss., on October 9 to take up the distribution of fish from the hatchery at that point. Trips were made to Jackson and Union, Miss., and Mobile, Ala., by the car, and messengers made nine detached trips from Tupelo. The species handled in this distribution were strawberry bass, catfish, crappie, largemouth black bass, and sunfish. The car left Tupelo on November 3 with a carload of fish for Chicago, arriving there on November 4.

Orders were received to proceed to La Crosse and Lynxville, Wis., to pick up a load of specimens and brood fish for Central Station, Washington, D. C. The car left Chicago on November 16 and arrived in La Crosse on November 17; specimens were obtained on November 25, and the car left the same day for Lynxville to obtain the remainder of the shipment. It left Lynxville the next day and arrived in Washington on November 28, completing the distribution for the calendar year.

Extensive repairs to the car were made at the Baltimore & Ohio shops during February, and the car was returned to Washington early in March.

The car left Washington on March 24 and arrived at Erwin, Tenn., on March 25 to distribute the output of trout from the hatchery at that point. Trips were made to Gainesville and Cornelia, Ga., Lake Toxaway, N. C., and Knoxville, Tenn. The species handled in this distribution were rainbow, Loch Leven, and brook trouts and rock bass. This distribution was completed on April 18, and the car proceeded to White Sulphur Springs, W. Va., to assist in distributing the output of trout of that station. Car trips were made to Wildell and Cass, W. Va., and Harrisburg, Scranton, and Philadelphia, Pa. On completion of the Philadelphia trip the car proceeded to Nashua, N. H., where a load of brook trout was obtained and taken to Portland, Me., and distributed to points near by. The car left Portland on May 24 and proceeded to Bucksport, Me., to take up the distribution from the hatchery at Craig Brook.

Carload plants of Atlantic salmon were made at Dover–Foxcroft, Dennysville, and Grindstone, Me. Trips with brook trout and landlocked salmon were made to Presque Isle, Calais, Kineo, Vanceboro, and Portland, Me. The Maine distribution was completed on June 22, and the car left Portland for Nashua, N. H., arriving on June 23, where it picked up a solid carload of brook trout, which were taken to Harrisburg, Pa., and distributed to points near by. The car left Harrisburg on June 28 and arrived at Omaha, Nebr., on June 30.

During the year the car made 38 trips, traveled 22,946 miles, and supplied 1,980 applicants. It handled 4,752,016 fish. Detached messengers made 98 trips and traveled 27,000 miles. The number and species of fish distributed by the car during the year are shown in the following table:

Species	Finger-lings No. 1	Finger-lings No. 2	Finger-lings No. 3	Finger-lings No. 4	Finger-lings No. 5	Adults
Catfish				1, 875		
Atlantic salmon	513, 150					
Landlocked salmon	173, 700					420
Rainbow trout	275, 600	566, 700	90, 240			
Black-spotted trout		784, 000	5, 000			31
Loch Leven trout	50, 400	187, 575				
Brook trout	1, 142, 400	584, 500	193, 450	5, 400		1, 800
Grayling						15
Crapple		26, 300				290
Largemouth black bass		8, 700	15, 640	11, 995	6, 000	150
Rock bass		5, 775				
Smallmouth black bass		525				
Strawberry bass		3, 250	4, 750	4, 650		170
Sunfish		46, 875	35, 635	3, 480	210	198
Yellow perch			1, 040			54
Miscellaneous fishes						73
Total	2, 155, 250	2, 214, 200	345, 755	27, 400	6, 210	3, 201

CAR NO. 9

[F. W. A. ENGLEHARDT, Captain]

This car completed the distribution from White Sulphur Springs, W. Va., in July and then proceeded to Colorado and took up the distribution of trout from the Leadville (Colo.) station. The Leadville distribution was completed on August 18, and the car proceeded to Neosho, Mo., where three carloads of fish were distributed prior to starting the distribution from the Langdon (Kans.) substation. Late in October the car departed from Langdon with a load of pondfishes for distribution in eastern Pennsylvania and Washington, D. C., arriving in Washington on November 1. After making several messenger shipments from Central Station and the Lakeland (Md.) ponds, the crew was detailed to work at fish-cultural stations during the winter months.

In February the car was taken to the shops of the Baltimore & Ohio Railroad at Baltimore for annual repairs and was returned to Washington on March 15, where the crew and equipment were assembled for the spring distribution of trout from the White Sulphur Springs station. The car left White Sulphur on June 13 for Bozeman, Mont., from where it made a shipment of trout to the Glacier National Park.

During the fiscal year the car and its messengers made distribution from White Sulphur Springs, W. Va., Leadville, Colo., Neosho, Mo., Langdon, Kans., Rifle, Colo., Washington, D. C., Orangeburg, S. C., Manchester, Iowa, and Bozeman, Mont.

The distribution included the following States: West Virginia, North and South Carolina, New Jersey, New York, Pennsylvania, Ohio, Virginia, Maryland, Nebraska, South Dakota, Iowa, Kansas, Oklahoma, New Mexico, Arizona, Missouri, Texas, Colorado, Arkansas, Wyoming, Montana, Illinois, Indiana, and Georgia.

The car made 35 trips during the year and traveled 27,085 miles, of which 680 were free. Messengers made 127 trips from the car and stations, supplying 2,028 applications. The number and size of the fish delivered by the car and its crew during the past fiscal year are shown in the following table:

Species	Finger-lings No. 1	Finger-lings No. 2	Finger-lings No. 3	Finger-lings No. 4	Finger-lings No. 5	Yearlings and adults
Catfish		23, 470			300	
Rainbow trout	297, 000	208, 450	69, 500	33, 150	24, 780	132
Black-spotted trout	164, 000		38, 500			
Loch Leven trout	154, 600	45, 400				
Brook trout	2, 483, 000	375, 410	127, 250	36, 350		18
Grayling						53
Crapple		2, 040	2, 230			
Largemouth black bass		38, 860	42, 470	6, 240	3, 264	
Smallmouth black bass						50
Rock bass	1, 400	600	200			
Sunfish	6, 600	23, 675	4, 300	3, 695		290
Yellow perch			4, 350		150	
Total	3, 106, 600	717, 905	288, 800	79, 435	28, 494	543